

# AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 22

DECEMBER, 1939

NUMBER 12

## PROPHYLACTIC AND THERAPEUTIC EFFECT OF BACTERIOPHAGE AND OF ANTIVIRUS IN EXPERIMENTAL STAPHYLOCOCCUS INFECTION OF THE EYE\*

J. BRONFENBRENNER, PH.D. AND S. EDWARD SULKIN, PH.D.

*Saint Louis*

Having failed to detect any therapeutic effect of the bacteriophage in the treatment of staphylococcus skin infection in experimentally infected animals,<sup>1</sup> we tried to find some other method of producing a local infection which would permit accurate observation of the lesion. The somewhat related experiments of Carrere<sup>2</sup> appeared to offer such an opportunity. This author investigated the prophylactic value of vaccination with Besredka's antiviral in experimental eye infections of rabbits and guinea pigs, and found it possible to protect the cornea or the anterior chamber of experimental animals by instillation of specific antiviral into the conjunctival sac, or by injection into the anterior chamber, respectively, 24 to 48 hours prior to the injection of the infecting organism. This protection was specific and limited to the treated eye. While such a procedure *a priori* appears inadequate because it is questionable whether the therapeutic agent reaches the actual site of infection by simple instillation into the conjunctival sac, we nevertheless decided to use this technique for the evaluation of both the prophylactic and therapeutic effect of bacteriophage, and incidentally repeat the experiments of Carrere with respect to

the efficacy of the antiviral in this connection.

### METHOD OF PRODUCING THE LESIONS

Albino rabbits and guinea pigs were used because of the ease with which changes in opacity of the cornea and hyperemia of the iris could be detected. Injections of bacteria were made as follows: The animal was locally anesthetized by dropping 10-percent cocaine into the conjunctival sac. After two or three minutes approximately 0.1 c.c. of anterior-chamber fluid was removed by inserting a 27-gauge hypodermic needle (with tuberculin syringe attached) into the anterior chamber. The syringe was exchanged for one containing bacterial suspension, leaving the needle *in situ*. The bacteria were injected through the same needle. In order to evaluate the effect of the trauma incident to this procedure, control rabbits and guinea pigs were given anterior-chamber and intracorneal injections of physiological salt solution, using exactly the same technique.

### APPEARANCE OF THE LESIONS

In the control animals receiving intracorneal injection of saline, the inoculation was followed by a very slight reaction. After 24 hours there was only a faint clouding at the site of the inocula-

\*From the Department of Bacteriology and Immunology, Washington University School of Medicine.

tion with slight injection of the ocular conjunctiva just above the sclerocorneal junction. This traumatic reaction sometimes persisted for four or five days, but generally disappeared after 48 hours.

The control anterior-chamber injections of saline were followed by a slightly more pronounced reaction. After 24 hours there was a slight clouding about the site of inoculation and only an insignificant injection of the vessels of the scleral conjunctiva just above the punctured quadrant of the cornea. A delicate network of vessels appeared to descend into the cornea from the conjunctival vessel nearest the area injected. These vessels, visible under magnification, persisted for a few days, after which they were not detectable even by careful examination with a hand slitlamp (fig. 1).

The usual reactions following the injection of the staphylococci may be briefly described as follows: On the day following the inoculation of bacteria there was a moderate injection of the vessels of the scleral conjunctiva above the injected area particularly along the superior rectus muscles. The degree of injection gradually increased in intensity and at times was so marked that the changes observed earlier in the sclera were almost completely obliterated due to the intense hyperemia. The iris appeared hyperemic and about four or five days after the injection of the bacteria seemed to be thrown into folds (syn-echiae, fig. 2). In the more severe reactions there was a distinct congestion of the palpebral conjunctiva with varying degrees of swelling and edema of the lids (fig. 3). In the eyes showing a marked reaction there frequently developed a mucopurulent inflammatory exudate in the conjunctival sac which was occasionally so abundant that it glued the lids together. Cloudiness of the cornea occurred simultaneously with the injection

of the conjunctival vessels. In several cases this clouding was intensified by the reaction in the anterior chamber so as to give the picture of hypopyon. Definite encroachment of the conjunctival vessels on the cornea became evident 24 to 48 hours after the injection of the bacteria. The vascularity first appeared as a delicate network of vessels just over the limbus. As the encroachment progressed the vessels formed delicate anastomosing loops, and as the reaction further increased in intensity the vessels descended further over the cornea and appeared as a curtain of brushlike processes extending over the entire circumference of the cornea. In exceptional cases the eye became the site of a marked inflammation leading to a panophthalmitis suggestive of keratitis profunda and atrophy (fig. 4). In most cases, however, the injected eyes returned to a normal appearance in the course of several weeks. The corneal reaction began to recede about two or three weeks after the injection of the bacteria. The blood vessels on the cornea, in some instances, remained grossly visible for several weeks or months. In the case of the intracorneal injections, the vessels persisted as a fine network of capillaries surrounding the injected area—so-called salmon patch. The gradual diminution in the conjunctival congestion was usually followed by a decrease in the opacity of the cornea until only a slight clouding or scar could be seen by examination with the hand slitlamp.

#### EXPERIMENTAL

Although we were primarily interested in the therapeutic effect of bacteriophage, we decided in the preliminary experiment to follow as closely as possible the procedure used by Carrere, who employed the antiviral prophylactically by instillation into the conjunctival sac of animals,

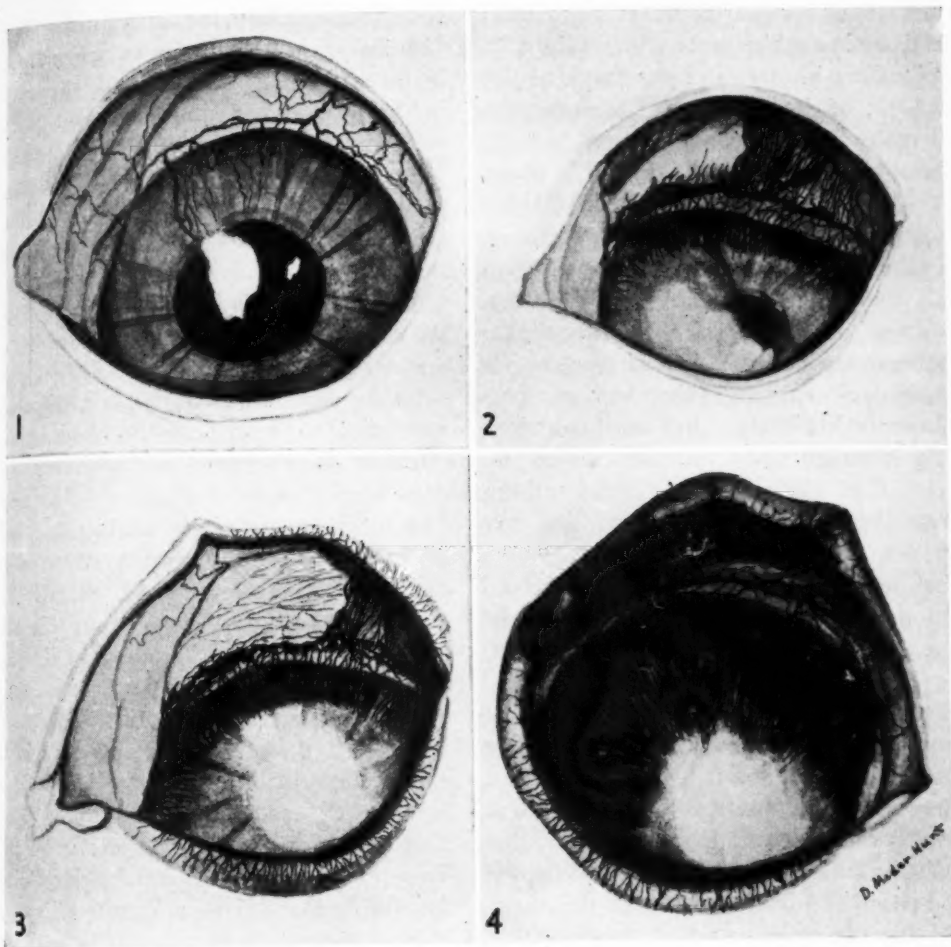


Fig. 1 (Bronfenbrenner and Sulkin). Network of vessels disappearing after a few days, a 1+ reaction.

Fig. 2 (Bronfenbrenner and Sulkin). Hyperemia and synechia, a 2+ reaction.

Fig. 3 (Bronfenbrenner and Sulkin). Congestion of palpebral conjunctiva and edema of the lids, a 3+ reaction.

Fig. 4 (Bronfenbrenner and Sulkin). Panophthalmitis suggesting keratitis profunda, a 4+ reaction.

24 to 48 hours prior to the introduction of bacteria. Throughout all these experiments the agent under investigation (bacteriophage or antiviral\*) was instilled into the right eye of the animal, while the left eye in each case received instilla-

tion of sterile broth as control. In the first experiment two guinea pigs each received two drops of staphylococcus bacteriophage into the conjunctival sac of the right eye, while the left eye of each received two drops of sterile broth. Similarly, two other guinea pigs received instillations of staphylococcus antiviral and broth into the right and left eyes, respectively. These instillations were repeated

\*The antiviral was prepared according to the method described by Besredka, A. Local immunization. Baltimore, Williams and Wilkins Company, 1927.

every hour for four hours on the first day and again on the second day (eight instillations in all), and on the third day 0.1 c.c. of a suspension of a moderately invasive staphylococcus (from an 18-hour-old agar culture so diluted in physiologic salt solution as to contain 5,000,000 organisms per cubic centimeter) was introduced intracorneally into each eye of all four guinea pigs. As an additional control, one guinea pig received a similar intracorneal inoculation of bacteria in both eyes without having had any preliminary instillation, and another guinea pig received only an intracorneal injection of salt solution in order to indicate the effect of the trauma. The eyes of the animals were observed daily over the period of seven weeks and the record of these observations was made in terms of the arbitrary scale as described earlier.

In no case was the infection prevented by the previous instillations of antiviral or bacteriophage (contrary to expectation on the basis of the findings of Carrere), nor was there observed any difference in the duration of the reaction beyond that which could be ascribed to individual differences of animals. For example, in one of the two animals which received preliminary instillations of antiviral in the right eye, and of sterile broth in the left eye, the infection of both eyes was so severe that it resulted in loss of both eyes in 36 days after the injection of bacteria, while the eyes of the other similarly treated guinea pig returned to normal after about 40 days, as determined by careful examination with the hand slitlamp. Both eyes of the control animal receiving bacterial injection alone returned to normal after about 48 days.

A similar experiment was carried out in rabbits. In this group of animals, however, following the preliminary instillations into the conjunctival sac of antiviral or bacteriophage, the bacteria

were injected into the anterior chamber (instead of intracorneally as before). As in the preceding experiment a variation in the intensity of the reactions, due to the individual peculiarity of the animals, was also noted. The results were essentially the same as those obtained with the guinea pigs in showing that preliminary instillations of antiviral or bacteriophage into the conjunctival sac did not protect the cornea or the anterior chamber of the eye against a severe injection.

In the next series of experiments we attempted to determine the therapeutic effect of bacteriophage and antiviral. In these experiments five guinea pigs and five rabbits were given an intracorneal injection into each eye of a suspension of staphylococcus prepared exactly as described before. Twenty-four hours later the right eye of each animal was subjected to copious washing (by slow instillation into the conjunctival sac of 5.0 c.c. of the therapeutic agent) with either bacteriophage or antiviral. The left eye of each of these animals was similarly washed with plain sterile broth. This procedure was repeated twice daily for a period of 7 days and once daily for 15 days thereafter. During the first three weeks of observation the condition of the eyes was recorded prior to each application of the therapeutic instillation. The severity of the reactions was recorded daily during and after cessation of treatment for a total period of 66 days. Neither the antiviral nor the bacteriophage seemed to have any favorable effect on the course or duration of the infection. On the contrary, in the right eye of a rabbit receiving instillations of antiviral, and in the right eye of the rabbit receiving instillations of bacteriophage, the intensity of the reactions were somewhat more severe and persisted longer than in the left eyes (control) of the same animals which received instilla-

tions of plain broth. While these differences were not very pronounced, we believe that they are significant, since similar deleterious effects were observed by us while studying the effect of bacteriophage on experimental infection in the skin. Subsequent experiments, which are to be reported presently, suggest that this temporary intensification of the local reaction is due in all probability to the presence in the bacteriophage as well as in the antiviral substances capable of increasing the invasiveness of the staphylococcus.<sup>3</sup>

## CONCLUSIONS

1. Instillations of antiviral or bacteriophage into the conjunctival sac are not sufficient to protect the cornea or the anterior chamber of the eye against a severe infection.
2. Direct application of antiviral or bacteriophage is of no value in the treatment of eyes experimentally infected with staphylococci.
3. Furthermore, intensification of the local reaction frequently results from the application of bacteriophage or antiviral to the lesion.

## BIBLIOGRAPHY

- <sup>1</sup>Bronfenbrenner, J., and Sulkin, S. E. Jour. Inf. Dis., 1939, v. 65, p. 53.  
<sup>2</sup>Carrere, L. Ann. l'Inst. Pasteur, 1925, v. 36, p. 67; Bull. Soc. Opht., 1924, p. 106.  
<sup>3</sup>Bronfenbrenner, J. and Sulkin, S. E. Proc. Soc. Exper. Biol. and Med., 1935, v. 32, p. 1419.

## A NOTE ON THE IMMUNOLOGY OF TRACHOMA\*

L. A. JULIANELLE, PH.D.  
*Saint Louis*

Beginning with the original observation of Nicolle, Cuénod, and Blaizot,<sup>1</sup> there have been a number of reports<sup>2</sup> on the treatment of trachoma by auto-inoculations of trachomatous virus. From such treatment based on the principle of active immunization, other studies have arisen adopting the converse of this concept;<sup>3</sup> namely, administration of auto- or "immune" blood, particularly by way of the conjunctiva. While specific therapy of this kind has not been so universal as to supersede the more routine treatment with metallic salts, it has been nevertheless interesting to determine whether the general rationale of specific immunization to trachoma possesses any inherent possibilities establishable by experimental methods.

Previous observations from this laboratory<sup>4</sup> have already demonstrated that recovery of monkeys from experimental infection does not evoke any measurable degree of immunity, and that the blood of patients<sup>5</sup> contains no antibodies capable of protection against the experimental disease. Since in both instances, however, the virus of trachoma does not penetrate beyond the conjunctiva, it is possible that the absence of antibody in the general circulation may be as much the result of an inadequate stimulation of the tissues responsible for formation of antibodies as an incompetency of the antigenic activity of the virus. It therefore seemed logical to extend the original studies on

immunity with observations on the antibody response of animals to prolonged artificial immunization.

Accordingly, both rabbits and monkeys (*M. rhesus*) have been immunized by repeated intravenous injections of tissues scraped by grattage from the conjunctiva of patients with clinically active disease. The scraped material was suspended in veal-infusion broth and after trituration under sterile precautions it was injected into the animals. Fresh material was obtained for each administration, and all the animals received 16 injections over a period of two months. Since the majority of tissues employed for the purpose contained inclusion bodies, it is clear that the tissues were not only typical of the disease, but if these structures play any part in the antigenicity of the virus, then any antigenic deficiency dependent upon their presence was precluded. It was not possible, however, to test the activity of the virus used for immunization, since the time required for its determination exceeds the survivability of the infectious agent.<sup>6</sup> It is a fair assumption, however, as demonstrated repeatedly in the laboratory,<sup>7</sup> that at least half the tissues utilized were infectious for monkeys. The animals injected were two normal rabbits and two monkeys. The latter were selected because they had recovered from experimental trachoma, thus indicating their susceptibility to the disease and, therefore, their suitability for studies on the formation of immune bodies.

Neutralization tests were subsequently conducted to determine the presence of antibodies in the blood of the animals immunized artificially. Scrapings pooled from several patients were mixed, after grinding, with the sera diluted 1:1, 1:3,

\*From the Department of Ophthalmology, Washington University School of Medicine. Conducted under a grant from the Commonwealth Fund of New York.

Presented before the Association for Research in Ophthalmology, Saint Louis, May 16, 1939.

and 1:5. The mixtures were then incubated at 37°C., for periods of 30 or 60 minutes, and agitated from time to time to insure maximum exposure of the suspension to the serum. In each instance, it was noticed that the sera both agglutinated and lysed the human cells in the scrapings. Smears made at the end of the period of incubation revealed a complete disappearance of the red blood cells and less complete but marked lysis of the polymorphonuclear cells, with the lymphocytes more resistant to this lytic action than the other blood constituents. While some of the epithelial cells were in various stages of dissolution, about half of them appeared to be more or less normal. For purposes of control, the tissue suspensions were incubated with equivalent quantities of normal rabbit and normal monkey sera, as well as in physiological saline solution. The lytic effect described in the case of the "immune" sera did not occur in these instances. It is clear, therefore, that the conditions of immunization allowed the formation of antibodies to functionable antigens present in the scrapings.

Following incubation, materials from the different tests were inoculated in monkeys (*M. rhesus*), usually by swabbing the conjunctiva of one eye, and by first pricking the conjunctiva of the opposite eye with a charged needle and then injecting subconjunctivally 0.2 c.c. to 0.4 c.c. of the mixtures.

Seven experiments were conducted as described, and in four the original tissues were not infectious for monkeys. In the remaining three experiments it was found that human tissues inoculated after exposure to sera prepared as outlined retained their full capacity to infect monkeys. The experimental trachomatous infections induced by the "immune" serum-suspension mixtures were in every way similar to those induced by grattage material undergoing similar treatment with

normal sera or broth. The conclusion seems unavoidable, therefore, that prolonged artificial immunization of rabbits, or of monkeys susceptible to trachoma, does not stimulate antibodies capable of neutralizing the virus, as determined by infection in monkeys.

The data suggest, then, that the treatment of patients by autoinoculation of conjunctival scrapings or by administration of their own sera does not appear from the experimental evidence to be an effective method for the control of clinical trachoma. This does not imply, however, that the virus of trachoma is not antigenic; it is more likely that the antigen is of low activity and what antibodies may be formed are beyond the range of detection by the methods now in use. The virus existing, as it does in spontaneous infection, only in close association with the conjunctival and corneal cells—both tissues only mildly concerned, if at all, in the elaboration of antibodies—lack of antibody response in the patient is readily understood. Since even repeated intravenous introduction of the virus into susceptible animals (that is, *M. rhesus*) fails in exerting adequate stimulation for the formation of antibodies, it must be admitted that the virus is at least an impotent antigen.

If, therefore, any implications are justifiable as a result of this study, then one of the most interesting would seem to be that in trachoma is witnessed a remarkable example of exalted parasitism between the virus and the infected tissues. This condition may in turn provide the explanation for the clinical character of the disease. The virus is of low infectivity, incapable of invasion, adapted to a high degree of tissue selectivity or specialization, slow in multiplying, and when removed from its natural environment rapidly inactivated. Consequently, it creates in infection a relatively minor dis-

turbance of the tissues involved. The disease acquires importance not because of its serious infection, but because of the corneal complication and probabilities of varying degrees of visual impairment. The same degree of infection in a less delicate tissue or organ would be of little clinical or pathological importance. In any case, the relatively mild reaction in the localized tissues and the failure to invade beyond the initial portal of entry are insufficient stimuli for the formation of antibodies. Thus, by this very deficiency, pathogenically and antigenically considered, the virus of trachoma maintains

conditions for its indefinite survival, creating in this way a state of almost perfect parasitism (that is, the ability to survive at the expense of a host without stimulating a significantly defensive reaction on the part of the host).

#### CONCLUSION

Artificial immunization of rabbits and susceptible monkeys, accomplished by repeated intravenous injections of conjunctival scrapings from the eyes of patients with clinically active trachoma, does not stimulate antibodies capable of neutralizing the virus of this infection.

#### REFERENCES

- <sup>1</sup> Nicolle, C., Cuénod, A., and Blaizot, L. *Compt. rend. Acad. Science*, 1913, v. 156, p. 1177; see also, *Arch. Inst. Pasteur Tunis*, 1913, v. 3-4, p. 157.
- <sup>2</sup> Trabut, C., Negre, L., and Raymond, M. *Compt. rend. Soc. Biol.*, 1913, v. 74, p. 1176.
- Derkač, V. *Arch. of Ophth.*, 1937, v. 138, p. 270.
- <sup>3</sup> Angelucci, A. *Arch. Ottal.*, 1925, v. 32, p. 488.
- Salvati, G. *Zentralbl. f. d. ges. Ophth.*, 1926, v. 17, p. 392.
- Kogan, N. *Ibid.*, 1927, v. 19, p. 203.
- Martinez, E. S. *Rev. Internat. Trachom*, 1937, v. 14, p. 19; also 1938, v. 15, p. 87.
- DeLord. *Bull. Soc. Ophth.*, Paris, 1937, p. 372.
- <sup>4</sup> Julianelle, L. A., and Harrison, R. W. *Amer. Jour. Ophth.*, 1934, v. 17, p. 1035.
- <sup>5</sup> Julianelle, L. A., Harrison, R. W., and Morris, M. C. *Jour. Exp. Med.*, 1937, v. 65, p. 735.
- <sup>6</sup> Julianelle, L. A., and Harrison, R. W. *Amer. Jour. Ophth.*, 1938, v. 21, p. 529.
- <sup>7</sup> Julianelle, L. A. *The etiology of trachoma*. New York, The Commonwealth Fund, Division of Publications, 1938.

#### DISCUSSION

DR. WILLIAM L. BENEDICT (Rochester, Minn.): I should like to ask the author if he has any notion as to whether the low antigenic properties he has demonstrated by his experiment have any bearing on whether or not the etiologic agent of trachoma is really a virus.

DR. LOUIS A. JULIANELLE: There is an unfortunate impression that was caused by Rivers's book on viruses, published about 10 years ago, in which he generalized so thoroughly as to what a virus should be. He flat-footedly states in that book that all viruses are very fine anti-

gens and the result is that recovery from a virus disease gives a life-lasting immunity.

At that time we did not know many viruses, and the statement was about 90 percent true. Today, it is about 60 percent true. We have come to know a number of viruses since then that do not give any measurable immunity or any very extensive immunity. I think, therefore, that one cannot define the nature of an infectious agent by the extent of immunity alone.

# VITAMIN-D COMPLEX IN PROGRESSIVE MYOPIA\*

ETIOLOGY, PATHOLOGY, AND TREATMENT  
PRELIMINARY STUDY

ARTHUR ALEXANDER KNAPP, M.D.  
*New York*

The etiology of progressive myopia has always been a problem. The theories that have been advanced may be divided into groups characterizing the etiology as mechanical, hereditary, and acquired. Under the acquired causes vitamin deficiency has been mentioned without being emphasized. From experimental work which Blackberg and I have done on dogs in the Department of Pharmacology, Columbia University,<sup>1</sup> and from clinical application of these laboratory findings, it seems that vitamin deficiency deserves greater stress in considering the etiology of progressive myopia. The improvement that has been shown in myopia treated from this standpoint has been so encouraging that we may hope that the cause of this visual defect is nearer solution. It is with this thought in mind that this brief report is made. Further, it is hoped this paper may act as a stimulus to other observers to check our results.

Rohmer and Bezsnoff<sup>2</sup> have said "The clinical recognition of vitamin deficiency states is no longer confined to the diagnosis of the classical picture. Knowledge must be extended to the recognition of the 'Forme Frustes' by a greater appreciation of how the specific vitamin functions in maintaining nutritional balance under normal and pathologic conditions." Strebel<sup>3</sup> has shown that the normal sclera is rich in calcium. Buffington,<sup>4</sup> in a discussion of myopia, states "Calcium deficiency is often present in progressive myopia." Fourteen out of 15 cases

of progressive myopia examined by Fleming<sup>5</sup> showed a low blood calcium. Wood<sup>6</sup> has found calcium deficiency in rapidly advancing myopia. Walker<sup>7</sup> and Sorsby et al,<sup>8</sup> too, are of the opinion that myopia is scleral rickets.

The production of axial myopia in the experimental animal presents intrinsic difficulties, but it seems that it is not an entirely impossible task. Tron<sup>9</sup> has shown that the anteroposterior diameter of the eyeball cannot be used as a criterion, for emmetropic, hyperopic, and axial myopic eyes show wide individual variations. The fact is, the myopic eye may have an even smaller anteroposterior diameter than the hyperopic. Nor does retinoscopy in the presence of ectasia of the cornea offer any aid in the laboratory animal. Hence, we must content ourselves with indirect evidence of the presence of induced myopia in the animal.

Prominence of the eyes, wide palpebral fissures, and deep anterior chamber are very frequently associated with axial myopia in the human. Keratoconus and complicated cataract are unusual findings. All of our animals, fed a deficient vitamin-D-low-calcium diet, developed these eye changes. They may be interpreted as suggestive of the presence of myopia. Ectasia of the cornea, alone, may be sufficient to cause myopia. True axial myopia, the type usually seen in man, is particularly characterized by stretching of the sclera. Sir Arthur Keith<sup>10</sup> remarks, "If the sclerotic fibroblasts lay sound material and lay it rightly, then all is well, whatever be the usage we give our eyes. But, if the ma-

\* Presented before the Association for Research in Ophthalmology in Saint Louis, May 16, 1939.

terial is unsound and laid wrongly, then it is possible that forces which leave the normal eye unaffected may damage the abnormal eye."

Clinically, our rachitic dogs manifested primary ectasia of the cornea. Histologic examination of the membrane showed definite pathology which grew progressively worse with the advancement of the deficiency. Edema of the substantia propria and irregularity of the lamellae were the principal changes. The sclera showed a similarly altered structure (figs. 1 and 2). These abnormal findings are an expression of the weakened fibrous tunic. Wood<sup>11</sup> has said "When the cornea gives way, the sclera does also." Argañaraz<sup>12</sup> regards axial myopia as having the same origin as primary ectasia of the cornea. In a recent study of 18 human eyes<sup>13</sup> I have shown that the vitamin-D complex is to be considered in the etiology of keratoconus.

A careful consideration of the clinical and pathologic findings in our animals leads to the conclusion that myopia probably has been induced in them by feeding a deficient vitamin-D-low-calcium diet.

Assuming a disorder of the vitamin-D-complex metabolism to be a basic factor in the etiology of myopia, certain facts readily are explained: The rarity of myopia in the American Indian; the fact that the rural inhabitant is freer from this complaint than is his city brother; that fewer myopic eyes are found in high altitudes; the prevalence of myopia in China. As for monocular myopia, it is Wiener's belief<sup>14</sup> that it cannot be considered as an entity separate from the binocular variety. It may be that our greater food-consciousness, especially in relation to vitamin supply, explains why we are seeing fewer cases of progressive myopia today.

From thousands of cases at the New York Eye and Ear Infirmary, and from

some in my private practice, I have selected 53 patients for this study. Their periods of observation varied from 5 to 28 months. All of them were chosen because it was believed that their myopia would progress. Their age and past and present refractive errors were considered. The ages were from 3 to 20 years. Their myopia ranged from  $-0.25D.$  to  $-41D.$  Vitamin D, in the form of Viosterol, and calcium, in the form of Mineral Mixture Tablets were prescribed.<sup>15</sup> Dosage of the latter varied with the milk intake. If a patient drank one quart of milk daily, one tablet was prescribed. For each glass less than this, two tablets were added. During the first three months the majority had been taking their medication three times a day, after meals. After that time, the tablets were prescribed before breakfast, all in one dose, and the Viosterol, 60 drops, after the meal. This changed routine was adopted because it has been found that calcium is best absorbed in an acid medium. Otherwise, the patients' diet and regimen were unchanged.

The cycloplegic employed for the refractions previous to my supervision, in most cases, was not known. The atropine tests were made after the patients had had one drop of 1-percent atropine three times daily for three days, and a tenth drop on the morning of examination. Blood-serum calcium and phosphorus investigations were made in a few patients, but in too few to permit any conclusion to be drawn. Because of the laboratory limitations, more calcium and phosphorus studies were not obtained. It would be of value to carry on further research in myopia along these lines, to determine the blood-serum calcium and phosphorus, the amount of diffusible and nondiffusible calcium, and also the ionizable fraction. In addition, calcium-balance studies would be interesting, with a check of the urinary and fecal output.

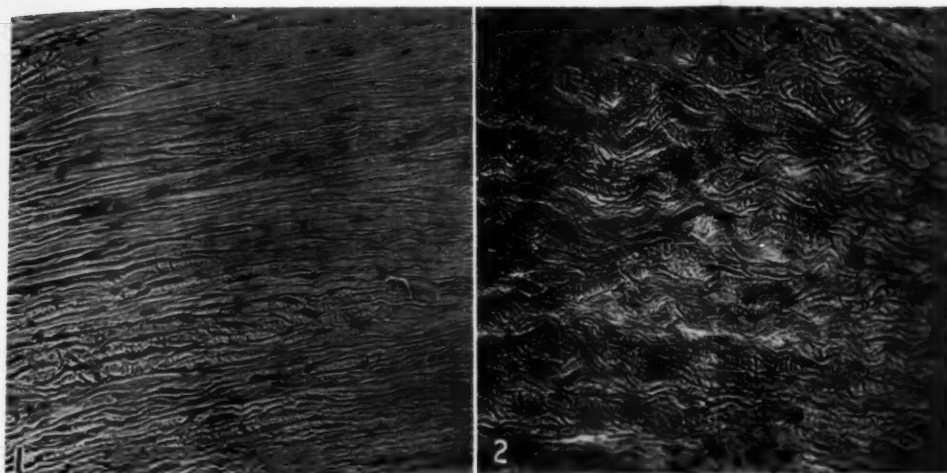


Fig. 1 (Knapp). Normal sclera of the dog.

Fig. 2 (Knapp). Corresponding area of sclera of dog after it had been on vitamin-D deficient, low-calcium diet for seven months, showing edema and irregularity of fibers.

#### RESULTS

Of the 53 cases, insufficient data were obtained on 7. In the remaining 46, only 12 patients took their medication regularly. Six of these 12 showed a reduction in their myopia; 2 remained stationary, 4 progressed. Considering the 46 patients, without regard to the regularity of medication, we find that 16, or 34.72 percent, had a reduction in their myopia; 7 of them, or 15.19 percent, remained stationary; 21, or 45.57 percent, progressed; and 2, or 4.34 percent, displayed a decrease of myopia in the left eye and a progression in the right. In other words, 66.67 percent of the patients who regularly took their medication either manifested a reduction in their myopia, or remained stationary. Taking into consideration the entire series, 50 percent revealed either a reduced myopia or were unchanged on reexamination.

To check further the influence of the administration of the vitamin-D complex on the human fibrous tunic, measurements of the cornea and the exposed scleral segment were made from plaster-of-Paris casts of the eyes with anterior-

curvature myopia before and after treatment with vitamin D and calcium. These figures were computed by Professors Carlos de Zafra and Louis Granath of the engineering and physics departments, respectively, of New York University. Very accurately they have shown that the cornea and the sclera, too, actually may shrink following this therapy. Scleral shrinkage also was found in both eyes of a patient with progressive myopia of 20.0 D., who, after the treatment period of eight months showed a reduction of 2.0 D. Clinically, this fact is well illustrated by two of the patients, who, without loss of weight or evident pathology of the levator palpebralis, developed a ptosis following the medication.

One of our patients, case 16, had been taking the Viosterol and Mineral Mixture Tablets for eight months. Atropine retinoscopy then showed less myopia in both eyes. After the patient had been without the prescribed therapy for eight months, atropine retinoscopy indicated an increase. Following another eight months of persistent taking of the medication, the condition again revealed

TABLE 1\*  
DATA ON VITAMIN D COMPLEX IN PROGRESSIVE MYOPIA

No.	Name	Age	Sex	Date	Previous Refractions Before Therapy	Date	Initial Atropine Refractions Retinoscopy Acceptance At One Meter	Vision	Medication Daily	Date	Subsequent Atropine Refractions Retinoscopy Acceptance At One Meter	Vision	Period of Observation	Regularity of Medication	Remarks
1.	B.H.	20	F.	1933	O.D. -20.00 -1.00 X 180 O.S. -22.00 Sph.	1/19/35	O.D. -40.00-2.00 X 180 O.S. UNIMPROVED MOVES LENTS AT 6 INCHES.	-20/70	VIOTEROL GITS LX MINI-TABS V	1/19/35	O.D. -32.00 -2.00 X 15 O.D. -31.00 -2.00 X 15 O.S. UNIMPROVED O.D. -28.00 -1.00 X 15 O.S. -28.00 -1.00 X 15	20/70 15/50 15/50	20 MONTHS	REGULAR	PATIENT HAS A MYOPIC CATALACTIC CATARACT OF BOTH EYES. ACNE OF FACE HAS DISAPPEARED
2.	M.O.	10	F.	2/2/32	-13.00 -11.00 -11.00	3/16/35	-14.75 -13.50	20/40 +	VIOTEROL GITS LX MINI-TABS IV	11/2/35	-15.25 -13.50	20/40 +	17 MONTHS	REGULAR	AFTER THREE MONTHS NOTICED THAT VISION WAS IMPROVED WITH AND WITHOUT GLASSES. SLEEPS BETTER. AFTER THREE MONTHS OF MEDICATION PRIOR TO 4/1/36 REFRACTION
3	A.A.	6	F.	4/20/34	-11.00 O.U.	5/5/35	-12.00 ACCEPTS O.D. -13.00 SPH O.S. -12.00 -1.00 X 180	20/40 20/40	VIOTEROL GITS LX MINI-TABS VI	9/22/35	-11.50 -10.75 ACCEPTS O.D. -12.50 SPH O.S. -12.50 SPH ACCEPTS O.D. -10.00 -1.00 X 175 O.S. -9.50 -1.00 X 175 ACCEPTS O.D. -9.25 -1.00 X 175 O.S. -10.25 -1.00 X 175	20/40 20/40 20/40 + 20/40 + 20/40 + 20/40 +	25 MONTHS	REGULAR	COD-LIVER OIL INTERMITTENTLY FOR A YEAR PRIOR TO OUR CARE. SEES BETTER WITHOUT GLASSES. BUT SO FINNETY AND NERVOUS. HAD MUSCLES
4	F.A.	15	M.	5/15/35	HAS O.D. -12.50 -1.00 X 180 O.S. -10.50 -1.00 X 180	5/15/35	-12.00 -10.75 ACCEPTS O.D. -13.50 SPH O.S. -11.50 -1.50 X 140	20/40 20/40	VIOTEROL GITS LX MINI-TABS VI	10/8/35	-12.00 -11.00 ACCEPTS O.D. -11.75 -1.25 X 15 O.S. -10.75 -1.25 X 15	20/30 20/30	5 MONTHS	REGULAR	SEES BETTER WITHOUT GLASSES. FEELS GOOD. NO PAIN. FEELING OF IM-PROVED HEALTH
5	A.A.	9	M.	5/1/35	-14.00 O.D. -12.50 -2.50 X 20 O.S. -13.00 Sph.	5/1/35	-12.00 ACCEPTS O.D. -12.50 -2.50 X 20 O.S. -13.00 Sph.	20/70 +	VIOTEROL GITS LX MINI-TABS VII	10/5/35	-13.50 -12.50 ACCEPTS O.D. -11.50 -3.50 X 20 O.S. -12.00 -1.50 X 160	20/50 20/50+ 20/50+	5 MONTHS	REGULAR	SEES BETTER WITHOUT GLASSES
6	R.M.	9	F.	4/24/34	O.D. -10.00 Sph. O.S. -10.00 -1.00 X 180	1/10/35	-10.25 -9.25 ACCEPTS O.D. -11.00 Sph. O.S. -10.00 -1.00 X 180	20/40 20/40	VIOTEROL GITS LX MINI-TABS VI	11/30/35	-9.50 -8.50 ACCEPTS O.D. -7.5 -2.25 X 180 O.S. -8.50	20/40 20/40	7 MONTHS	REGULAR	SEES BETTER WITHOUT GLASSES. IM-PROVED APPETITE. PLAYS MORE
7	L.M.	6	M.	10/25/34	-1.25 -1.25	2/23/35	-2.50 -2.25 ACCEPTANCE NOT RELIABLE	20/40	VIOTEROL GITS LX MINI-TABS IV	8/27/35	-2.75 -2.50 -2.25 -3.00	20/40 20/40 20/40 20/40	8 MONTHS	REGULAR	SEES BETTER WITHOUT GLASSES. FLEM PHONES. HAS TAKEN CALCIUM AFTER MEALS
8	H.B.	9	M.	2/16/35	HAS O.U. -1.50 Sph. (OLD PAIR) AND O.D. -5.00 -3.00 X 180 O.S. -4.00 -3.00 X 180	2/16/35	-10.00 -5.00 ACCEPTANCE UNSATISFACTORY	20/40	VIOTEROL GITS LX MINI-TABS IV	8/27/35	-10.00 -7.25 -5.00 -4.50	20/40 20/40 20/40 20/40	6 MONTHS	REGULAR	SEES BETTER WITHOUT GLASSES. FLEM PHONES. HAS TAKEN CALCIUM AFTER MEALS
9	S.P.	9	F.	3/2/35	-5.00 -4.50 ACCEPTANCE UNSATISFACTORY	3/2/35	-5.00 -4.50 ACCEPTANCE UNSATISFACTORY	20/40	VIOTEROL GITS LX MINI-TABS V	11/2/35	-5.25 -4.25 -3.25	20/40 20/40 20/40	8 MONTHS	IRREGULAR	HISTORY OF ALLERGY IN FAMILY. HISTORY OF ALLERGIC REACTIONS. POLAR CATARACTS. BLEEDER. HAS BEEN TAKING CALCIUM ELEPHANTINIS. HAS BEEN TAKING CALCIUM ELEPHANTINIS. HAS BEEN TAKING CALCIUM ELEPHANTINIS. HAS BEEN MISSED 25 MONTHS
10	R.L.	5	F.	10/8/32	-3.00 -2.00 -1.00 -1.00	4/18/35	-7.00 -7.25 ACCEPTANCE UNSATISFACTORY	20/40	VIOTEROL GITS LX MINI-TABS V	10/8/35	-7.00 -6.25 -5.25 -4.25	20/40 20/40 20/40 20/40	6 MONTHS	IRREGULAR	EUTROPIA. MEDICATION MISSED SEVEN WEEKS. BRONCHITIS

[illegible]

[illegible]

ED. NOTE: The following corrections and addenda were sent in by the author after cuts of the table had been made:

Headings of columns 8 and 11 should read "Retinoscopy and Acceptance."

Case 2: 4/1/36, —13.50 instead of —18.00.

Case 16: under Remarks, last sentence reads "Medication missed one month in first 8 months." Delete first date (5th col.).

Case 21: under Previous refractions before therapy, add 20/20 for both D. and O.S.

Case 32: under Date (5th col.) change to 11/16/34.

Case 46: Under Subsequent atropine refractions Retinoscopy and Acceptance the first examination was made 6/28/35

—3.00	—3.25	—3.50	{slant of broken line}	
0.250	0.250	0.250	{same as below}	
O.D. —3.50	—50	× 180	20/20	
O.S. —3.50	—75	× 15	20/20	

under Period of observation, 18 months instead of 20 months

under Remarks, add "Now vision without glasses improved."

TABLE 1  
DATA ON VITAMIN D COMPLEX IN PROGRESSIVE MYOPIA

No.	Name	Age	Sex	Date	PREVIOUS REFRACTION BEFORE THERAPY	INITIAL ATROPINE REFRACTION RETIOMETRY ACCEPTANCE	MEDICATION	DATE	SUBSEQUENT ATROPINE REFRACTIONS RETIOMETRY ACCEPTANCE	PERIOD OF OBSERVATION	REGULARITY OF MEDICATION	REMARKS
24	A.C.	10	M	2/26/34	20/20 O.D. -1.50 SPH. O.S. -1.50 SPH.	3/8/35 -1.00 O.D. -2.00 SPH. O.S. -2.00 SPH.	VIOSTEROL OTIS LX M.M. TABS 20/20 Vil	11/27/35	-1.00 O.D. -2.00 SPH. O.S. -2.00 SPH.	8 1/2 MONTHS	IRREGULAR	VISION BETTER WITHOUT GLASSES MEDICATION MISSED ONE MONTH, CALCIUM TAKEN AFTER MEALS
25	M.T.	13	M	2/13/34	20/20 O.D. -2.00 - .50 X 180 O.S. -1.50 -1.50 X 170	1/9/35 -2.00 O.D. -2.50 - .50 X 180 O.S. -1.75 -1.50 X 170	VIOSTEROL OTIS LX M.M. TABS 20/20 IV	8/3/35	-2.00 O.D. -2.50 - .50 X 180 O.S. -1.75 -1.50 X 170	6 MONTHS	IRREGULAR	VISION IMPROVED WITHOUT GLASSES, MEDICATION MISSED ONE MONTH
26	G.L.	6	M			5/2/35 -7.50 O.D. -7.50 O.S. -6.50	VIOSTEROL OTIS LX M.M. TABS 20/20 VI	12/22/35	-8.00 O.D. -7.50 O.S. -7.00	7 1/2 MONTHS	IRREGULAR	MISSED MEDICATION TWICE WEEKLY AND ONE MONTH CONSECUTIVELY
27	S.P.	15	M	4/21/34	145 O.D. -5.00 SPH. O.S. -5.50 SPH.	2/14/35 -12.50 O.D. -10.50 -3.00 X 165 O.S. -8.50 -1.25 X 15	VIOSTEROL OTIS LX M.M. TABS 20/20 Vil	11/30/35	-9.50 O.D. -10.50 -3.00 X 150 O.S. -8.75 -1.25 X 15	9 1/2 MONTHS	IRREGULAR	MISSED THREE MONTHS MEDICATION
28	G.F.	9	F	1/12/34	20/20 O.D. -75 -25 X 180 O.S. -1.50 SPH.	3/12/35 -1.50 O.D. -2.75 -25 X 90 O.S. -3.75 SPH.	VIOSTEROL OTIS LX M.M. TABS 20/20 VI	12/12/35	-2.50 O.D. -3.75 -25 X 90 O.S. -3.50 SPH.	9 MONTHS	IRREGULAR	MISSED TWO MONTHS MEDICATION, CALCIUM TAKEN AFTER MEALS
29	M.G.	13	M	1/13/34	20/20 O.D. -4.50 - .50 X 180 O.S. -4.75 - .50 X 180	3/2/35 -4.75 O.D. -5.25 - .50 X 180 O.S. -3.75 - .25 X 180	VIOSTEROL OTIS LX M.M. TABS 20/20 VI	11/30/35	-5.25 O.D. -5.00 - .25 X 180 O.S. -6.00 - .25 X 180	9 MONTHS	IRREGULAR	MISSED TWO MONTHS MEDICATION, CALCIUM TAKEN WITH MEALS, PSEUDOMONITIS O.U.
30	A.R.	3	F	10/3/34	20/20 O.D. -9.00 O.S. -9.50	1/22/35 -10.50 O.D. -9.00 O.S. -8.00	VIOSTEROL OTIS LX M.M. TABS 20/20 VI	12/12/35	-11.00 O.D. -10.50 O.S. -10.50	11 MONTHS	IRREGULAR	VISION IMPROVED WITHOUT GLASSES MISSED FOUR MONTHS MEDICATION
31	O.F.	7	F	10/14/33	5 O.D. -1.75 -4.00 X 5 O.S. -1.75 -4.00 X 175	2/2/35 -5.50 O.D. -2.75 -4.00 X 15 O.S. -2.75 -4.00 X 165	VIOSTEROL OTIS LX M.M. TABS 20/20 VI	12/20/35	-6.00 O.D. -3.50 -3.50 X 15 O.S. -3.25 -4.00 X 165	9 1/2 MONTHS	IRREGULAR	SLEEP IMPROVED, MISSED THREE MONTHS MEDICATION
32	V.C.	9	F	2/26/35	20/20 O.D. -3.00 SPH. O.S. -1.75 SPH.	2/26/35 -1.00 ACCEPTANCE UNSATISFACTORY	VIOSTEROL OTIS LX M.M. TABS 20/20 VI	8/21/35	-1.25 O.D. -1.25 O.S. -1.25	6 MONTHS	IRREGULAR	SLEEP AND APPETITE IMPROVED, MEDICATION MISSED ONE MONTH
33	M.H.	9	M	10/5/34	180 O.D. - .50 SPH. O.S. - .50 CYL. AS 180	2/9/35 -25 O.D. -25 - .50 X 180 O.S. -25 - .50 X 180	VIOSTEROL OTIS LX M.M. TABS 20/15 IV	10/8/35	+25 O.D. -1.25 - .25 X 180 O.S. -1.25 - .50 X 180	8 MONTHS	IRREGULAR	VISION IMPROVED WITHOUT GLASSES, FEWER COLOR THAN FORMERLY, MISSED MEDICATION 1 1/2 MONTHS
34	G.P.	13	F	11/7/34	180 O.D. -4.00 - .75 X 180 O.S. -6.00 -1.00 X 165	2/16/35 -3.75 O.D. -4.25 - .75 X 180 O.S. -7.25 - .75 X 165	VIOSTEROL OTIS LX M.M. TABS 20/20 V	12/3/35	-4.50 O.D. -4.50 -1.00 X 180 O.S. -7.50 - .75 X 165	9 1/2 MONTHS	IRREGULAR	MEDICATION MISSED FOUR MONTHS
35	M.R.	11	M	3/11/33	175 O.D. -3.50 SPH. O.S. -3.00 -1.00 X 175	2/16/35 -5.00 O.D. -5.00 -1.00 X 180 O.S. -3.50 -1.00 X 175	VIOSTEROL OTIS LX M.M. TABS 20/20 Vil	12/24/35	-5.00 O.D. -3.50 -1.25 X 180 O.S. -3.50 -1.25 X 180	10 MONTHS	IRREGULAR	VISION, APPETITE, AND SLEEP IMPROVED, MISSED THREE MONTHS MEDICATION, CALCIUM TAKEN WITH MEALS
36	B.S.	12	F	1/27/34	20/20 O.D. -5.25 SPH. O.S. -4.50 SPH.	2/16/35 -4.75 O.D. -5.25 SPH. O.S. -5.50 SPH.	VIOSTEROL OTIS LX M.M. TABS 20/20 Vil	11/30/35	-4.75 O.D. -5.25 - .25 X 180 O.S. -5.50 - .25 X 180	9 1/2 MONTHS	IRREGULAR	MEDICATION MISSED THREE MONTHS

No.	Name	Age	Sex	Date	PREVIOUS REFRACTIONS BEFORE THERAPY	DATE	INITIAL ATROPINE REFRACTION RETINOSCOPY ACCEPTANCE	VISION	MEDICATION	DATE	SUBSEQUENT ATROPINE REFRACTIONS RETINOSCOPY ACCEPTANCE	VISION	PERIOD OF OBSERVATION	REGULARITY OF MEDICATION	REMARKS
37	L.Z.	10	F	4/18/34 10/19/34	O.D. -3.00 - .25 X 90 O.S. -3.00 - .25 X 90 O.U. -3.00 - .25 X 90	2/28/35	O.D. -1.00 - .25 X 180 O.S. -2.00 - .25 X 180 O.S. -2.25 - .25 X 180	20/20 20/20 20/20	VIOSTEROL OTIS LX M.M. TABS V	8/13/35	O.D. -1.50 - .25 X 180 O.S. -2.25 - .25 X 180 O.S. -2.50 - .25 X 180	20/20 20/20 20/20	5 1/2 MONTHS	REGULAR	CALCIUM TAKEN AFTER MEALS
38	I.R.	7	F	3/3/34	O.D. -3.00 - .25 X 90 O.S. -3.00 - .25 X 90 O.U. -3.00 - .25 X 90	2/2/35	O.D. -2.75 - .25 X 90 O.S. -3.75 - .25 X 90 O.S. -4.00 - .25 X 90	20/20 20/20 20/20	VIOSTEROL OTIS LX M.M. TABS V	9/14/35	O.D. -3.00 - .25 X 90 O.S. -4.00 - .25 X 90 O.S. -4.25 - .25 X 90	20/15 20/15 20/15	7 MONTHS	REGULAR	CALCIUM TAKEN WITH MEALS
39	M.S.	12	M	10/26/34	O.D. -2.75 - .25 X 90 O.S. -2.75 - .25 X 90 O.U. -2.75 - .25 X 90	3/12/35	O.D. -2.25 - .25 X 180 O.S. -3.25 - .25 X 180 O.S. -3.50 - .25 X 180	20/20 20/20 20/20	VIOSTEROL OTIS LX M.M. TABS IV	11/30/35	O.D. -2.50 - .25 X 180 O.S. -3.50 - .25 X 180 O.S. -3.75 - .25 X 180	20/20 20/20 20/20	6 1/2 MONTHS	IRREGULAR	VISION IMPROVED WITHOUT GLASSES MEDICATION MISSED 2 1/2 MONTHS
40	R.Z.	10	M	12/27/34	O.D. -1.25 - .25 X 150 O.S. -1.25 - .25 X 150 O.U. -1.25 - .25 X 150	2/16/35	O.D. -1.25 - .25 X 150 O.S. -1.75 - .25 X 150 O.S. -2.00 - .25 X 150	20/20 20/20 20/20	VIOSTEROL OTIS LX M.M. TABS IV	10/26/35	O.D. -1.75 - .25 X 150 O.S. -2.00 - .25 X 150 O.S. -2.25 - .25 X 150	20/20 20/20 20/20	6 1/2 MONTHS	IRREGULAR	VISION IMPROVED. MEDICATION MISSED TWO MONTHS
41	F.J.	9	F	8/29/34	O.D. -1.25 - .25 X 150 O.S. -1.25 - .25 X 150 O.U. -1.25 - .25 X 150	3/5/35	O.D. -1.25 - .25 X 180 O.S. -2.00 - .25 X 180 O.S. -2.25 - .25 X 180	20/20 20/20 20/20	VIOSTEROL OTIS LX M.M. TABS IV	11/8/35	O.D. -1.50 - .25 X 180 O.S. -2.25 - .25 X 180 O.S. -2.50 - .25 X 180	20/20 20/20 20/20	8 MONTHS	IRREGULAR	BETTER VISION WITHOUT GLASSES MEDICATION MISSED ONE MONTH
42	J.D.	13	M		O.D. -1.25 - .25 X 150 O.S. -1.25 - .25 X 150 O.U. -1.25 - .25 X 150	1/15/35	O.D. -1.25 - .25 X 150 O.S. -1.75 - .25 X 150 O.S. -2.00 - .25 X 150	20/20 20/20 20/20	VIOSTEROL OTIS LX M.M. TABS IV	8/20/35	O.D. -1.75 - .25 X 150 O.S. -2.25 - .25 X 150 O.S. -2.50 - .25 X 150	20/20 20/20 20/20	7 MONTHS	IRREGULAR	VISION IMPROVED WITHOUT GLASSES MEDICATION MISSED 1 1/2 MONTHS
43	D.S.	10	M		O.D. -1.50 - .25 X 150 O.S. -1.50 - .25 X 150 O.U. -1.50 - .25 X 150	3/16/35	O.D. -1.75 - .25 X 150 O.S. -2.00 - .25 X 150 O.S. -2.25 - .25 X 150	20/15 20/15 20/15	VIOSTEROL OTIS LX M.M. TABS III	11/9/35	O.D. -2.00 - .25 X 90 O.S. -2.25 - .25 X 90 O.S. -2.50 - .25 X 90	20/15 20/15 20/15	8 MONTHS	IRREGULAR	VISION IMPROVED WITHOUT GLASSES MEDICATION MISSED ONE MONTH. CALCIUM TAKEN AFTER MEALS
44	R.C.	11	F	12/7/34	O.D. -5.00 - 1.50 X 20 O.S. -5.00 - 1.50 X 160 O.U. -5.00 - 1.50 X 160	2/16/35	O.D. -1.00 - .25 X 160 O.S. -1.75 - .25 X 160 O.S. -2.00 - .25 X 160	20/20 20/20 20/20	VIOSTEROL OTIS LX M.M. TABS VII	12/20/35	O.D. -1.25 - .25 X 160 O.S. -2.25 - .25 X 160 O.S. -2.50 - .25 X 160	20/20 20/20 20/20	10 MONTHS	IRREGULAR	BETTER VISION WITHOUT GLASSES MEDICATION MISSED 2 1/2 MONTHS
45	N.K.	19	M	2/29/29 3/1/33	O.D. -6.00 - 1.00 X 30 O.S. -6.00 - 1.00 X 25 O.S. -9.00 - 2.00 X 165	4/12/35	O.D. -12.00 - 3.00 X 30 O.S. -10.00 - 2.00 X 165 O.S. -12.00 - 3.00 X 165	20/70+ 20/70+ 20/70+	VIOSTEROL OTIS LX M.M. TABS VII	11/10/35	O.D. -12.25 - 3.00 X 30 O.S. -10.50 - 2.00 X 165 O.S. -12.25 - 3.00 X 165	20/50 20/50 20/50	6 MONTHS	IRREGULAR	ACNE OF FACE CLEARED. MISSED MEDICATION THREE WEEKS
46	S.M.	11	M		O.D. -2.50 - .25 X 150 O.S. -2.50 - .25 X 150 O.U. -2.50 - .25 X 150	2/4/35	O.D. -2.50 - .25 X 150 O.S. -3.25 - .25 X 150 O.S. -3.50 - .25 X 150	20/20+ 20/20+ 20/20+	VIOSTEROL OTIS LX M.M. TABS IV	1/2/36 9/14/36	O.D. -3.50 - .25 X 150 O.S. -4.25 - .25 X 150 O.S. -4.50 - .25 X 150	20/20+ 20/20+ 20/20+	20 MONTHS	IRREGULAR FOR 11 MONTHS REGULAR FOR 7 1/2 MONTHS	MEDICATION TAKEN THREE TIMES WEEKLY. FORTY DROPS TABLETS AFTER MEALS

a reduction. Another patient, case 46, only occasionally took his Viosterol and calcium for a period of 11 months. Atropine refraction brought out an increase in the myopia. Subsequent to 7½ months of regular medication there was a definite decrease.

As a result of this treatment, the majority of the patients noticed increased visual acuity for distance and near. Objectively, some showed better vision. They were not so dependent upon their glasses as formerly. For distinct near vision without lenses, they found that reading matter could be held at a greater distance from the eyes. Characteristic poor muscle tonus improved. In none of this series have I noticed irritative conjunctivitis symptomatic of vitamin-D toxicity. The only toxic symptoms observed were anorexia in three patients, nausea and vomiting in two, and a mild skin eruption in two.

#### CONCLUSIONS

From this study, it appears that a disturbance in the vitamin-D-calcium-phosphorus metabolism is concerned in the

etiology of myopia. In the presence of a calcium imbalance, there may be a weakening of the fibrous tunic, which may give rise to myopia. Once a condition of progressive myopia has been established, treatment with the vitamin-D complex is indicated. The myopic eyes that respond to this therapy may undergo an actual shrinkage of the globe.

For the prevention of the onset of myopia, the vitamin-D complex probably has another field of usefulness. Given a patient showing a diminishing degree of hyperopia, and one who is approaching the axial myopia side, it would be well to fortify his diet with vitamin D and calcium.

Assistance was given by Miss Diana Shrage of the social service department of the New York Eye and Ear Infirmary. My thanks are due the surgeons of the New York Eye and Ear Infirmary for permission to present these patients. To the Mead Johnson Company of Evansville, Indiana, I wish to express my thanks for their generosity in financing this work.

35 East Sixty-fourth Street.

#### BIBLIOGRAPHY

- <sup>1</sup> Blackberg, S. N. and Knapp, A. A. Ocular changes accompanying disturbances of calcium-phosphorus metabolism. *Arch. of Ophth.*, 1934, v. 11, April, pp. 665-669; The influence of vitamin-D-calcium-phosphorus complex in the production of ocular pathology. 1. A histological study of the changes in the fibrous tunic. *Amer. Jour. Ophth.*, 1937, v. 20, April, p. 405.
- <sup>2</sup> Rohmer, P. and Beznoff, N. Investigations into the pathogenesis of scorbutic dystrophy. *Arch. Dis. Child.*, 1935, v. 10, Aug., pp. 319-326.
- <sup>3</sup> Strebel, J. Qualitative inorganic analyses of the sclera in normal human eyes. *Schweiz. Med. Woch.*, 1931, v. 61, Nov. 14, p. 1102.
- <sup>4</sup> Buffington, W. R. Discussion of Dr. L. Bothman's paper in *Arch. of Ophth.*, 1933, v. 9, Feb., p. 306.
- <sup>5</sup> Fleming, N. Discussion of F. W. Law's paper, Calcium and parathyroid therapy in progressive myopia. *Trans. Ophth. Soc. U. Kingdom*, 1934, v. 44, pp. 281-290.
- <sup>6</sup> Wood, D. J. Calcium deficiency in the blood with reference to spring catarrh and malignant myopia. *Brit. Jour. Ophth.*, 1927, v. 11, May, pp. 224-230.
- <sup>7</sup> Walker, J. P. Progressive myopia. *Brit. Jour. Ophth.*, 1932, v. 16, Aug., pp. 485-488.
- <sup>8</sup> Sorsby, A., Wilcox, K., and Ham, D. The calcium content of the sclerotic and its variation with age. *Brit. Jour. Ophth.*, 1935, v. 19, June, pp. 327-337.
- <sup>9</sup> Tron, E. Variationstatistische Untersuchungen über Refraktion. *Arch. f. Ophth.*, 1929, v. 122, May, p. 1.
- <sup>10</sup> Keith, A. Near sight and civilization. *Brit. Jour. Physiol. Optics*, 1925, v. 1, Sept., p. 3.
- <sup>11</sup> See ref. 6.
- <sup>12</sup> Argañaraz, R. Myopias progresivas y perturbaciones endocrinas: Contribucion a su estudio etipatogenico. *Semana med.*, 1922, v. 20, p. 1161.

- <sup>10</sup>Knapp, A. A. Vitamin-D complex in keratoconus. Jour. Amer. Med. Assoc., 1938, v. 110, June 11, pp. 1993-1994.
- <sup>11</sup>Wiener, Meyer. Discussion of Dr. Jonas S. Friedenwald's paper at the meeting of the Amer. Acad. of Ophth. and Oto-Laryn., in Montreal, Can., Sept., 1932.
- <sup>12</sup>Viosterol and Mineral Mixture tablets kindly supplied by the Mead Johnson Company of Evansville, Ind. The Mineral Mixture tablet contains the following in milligrams: Calcium, 140; Phosphorus, 83; Iron, 1; Copper, 0.05; Magnesium, 2.8; Sodium, 5; Potassium, 5.

## DISCUSSION

DR. ALLEN GREENWOOD (Boston, Mass.): I would like to ask Dr. Knapp, in regard to his first patient, whether careful slitlamp examinations were made of the lens from time to time? He speaks of the lenses as being cataractous. I was wondering whether he kept careful slit-

lamp records from time to time of those lens changes, if there were any.

DR. ARTHUR ALEXANDER KNAPP: I will publish that case history as a separate entity. It was exceedingly interesting. The eyes were frequently examined with the aid of the slitlamp and a record kept.

## UNILATERAL LOSS OF VISION IN NEUROLOGICAL DISEASE\*

P. J. LEINFELDER, M.D.

*Iowa City, Iowa*

Gradual loss of vision in one eye is always an alarming symptom to the patient, and etiologic diagnosis is frequently difficult. Especially is this true in those cases in which external and ophthalmoscopic evidence of ocular or general disease is absent. Usually a diagnosis can be made in such cases only after careful general and neurologic examination, ophthalmoscopic study, estimation of the visual fields, and roentgenographic observation of the orbits, optic canals, and skull. In the roentgenograms, the pituitary fossa and the sphenoidal ridges are of special interest, for in this region pathology most frequently occurs. Repeated observations of the ocular and general condition must be made to determine new signs that would lead to a diagnosis of the underlying etiology. The visual acuity may remain stationary, and all efforts toward localization may fail, but when

vision progressively decreases in the interval between examinations, every effort must be made to determine the pathologic process. Although, on an anatomic basis, unilateral loss of vision can occur only as a result of pathology in a rather limited area at the base of the brain, a relatively large number of conditions can produce the symptom. Thoroughness and repeated observations will aid in obtaining an early diagnosis that will not only point out the causative pathologic condition, but also favor preservation or restitution of vision.

*Adenoma of the Pituitary Body.* Because, as was pointed out by Cushing,<sup>1</sup> the field of vision in pituitary tumors is frequently diminished first in one eye, unilateral loss of vision is often an early complaint. Headache may be an accompanying symptom, but the visual loss is usually more distressing to the patient. Since prominent, clinical signs of pituitary disease are absent in most cases, the necessity for close study of the visual

\*From the Department of Ophthalmology, College of Medicine, State University of Iowa, Iowa City, Iowa.

symptoms is imperative for early diagnosis. The visual fields usually suggest pathology in the region of the sella. In the earliest case, a superior quadrant or partial temporal defect may be noted, while the opposite eye retains a normal field. Vision is diminished in the affected eye even though the peripheral field may extend 10 to 20 degrees from the fixation point, and a central scotoma may not be demonstrated by quantitative perimetry on the tangent screen. It is only in a more advanced stage of the disease that the fellow eye presents a cut in the temporal field. The general effect therefore is not a homologous, bi-temporal field defect, but an incongruous one in which one eye is usually one quadrant in advance of the other. Roentgenographic examination of the sella turcica discloses enlargement of the sella, and erosion of the clinoids is seen in the cases that show only early field changes. The visual-field changes are undoubtedly later manifestations of pituitary-body disease that usually occur only after bone destruction has become quite advanced. Since the presence of a choked disc is unusual in pituitary adenoma and temporal pallor of the nerve heads is inconsistent, visual-field studies and roentgenograms of the sella are invaluable signs for the diagnosis of the intracranial lesion. In advanced cases, a marked reduction of vision may be present in one or both eyes. Optic atrophy is then present, and such cases may be mistaken for tabetic atrophy. A negative Wassermann reaction and roentgenograms of the skull eliminate the possibility of error.

*Meningioma of the Sphenoidal Ridge.* When a meningioma involves the medial aspect of the sphenoidal ridge, encroachment upon the optic nerve is almost axiomatic. Since the growth of these neoplasms is extremely slow, visual acuity may gradually decrease over a period

of years, but a small tumor involving the lesser wing of the sphenoid may produce pressure upon the optic nerve very early. Choked disc may be observed on one or both sides. In the unilateral cases, the papilledema, if present, may occur on the side opposite the tumor because of obstruction by the tumor of the vaginal sheaths at the optic canal. Visual fields may be irregular or may show concentric contraction or a nasal cut in the eye on the side of the tumor. Symptoms of pressure on the third, fourth, fifth, and sixth cranial nerves are sometimes observed. Unilateral exophthalmos is a frequent late complication of the disease. Roentgenograms disclose the typical bony changes in the region of the sphenoidal ridge and one or both optic canals may be narrowed or apparently obliterated.

*Multiple Sclerosis.* Rapidly progressing unilateral visual loss occurring in a young adult accompanied by a central scotoma but no objective signs of ocular disease may be the first sign of multiple sclerosis. This type of retrobulbar neuritis is usually seen in an otherwise apparently healthy young adult. Visual-field studies disclose a central defect that may vary from a relative one for color to a 10- to 15-degree absolute scotoma. Orbital tenderness is not induced by pressure on the globe. Initial neurologic examination may reveal no evidence of the underlying condition, but complete and repeated study will frequently disclose a change in the peripheral, sensory, or motor systems. Test of the cerebrospinal fluid by the Lange gold method may disclose the typical curve. It must be remembered that multiple sclerosis is a chronic disease characterized by remissions and exacerbations, and acute retrobulbar neuritis may be the earliest manifestation. Other clinical evidence of the disease may not be recognized for a period of years.

Ocular and neurologic literature contains many discussions concerning the etiology of unilateral acute retrobulbar neuritis, but it seems safe to say that the probability is exceedingly great that the young adult with monocular retrobulbar neuritis will later develop evidence of typical neurologic manifestations of multiple sclerosis. Adie<sup>2</sup> established that the age and sex incidence was the same for uncomplicated acute retrobulbar-neuritis and multiple-sclerosis patients in whom visual symptoms were the first indication of the disease.

In like manner the presence of reduced visual acuity in one eye accompanied by a temporal atrophy of the nerve head should suggest to the examiner the possibility of an old retrobulbar neuritis occurring in multiple sclerosis. In this condition, although the acute process is localized in the optic nerves, the underlying cause is a progressive disease of the central nervous system, and general symptoms and signs eventually occur.

**Intracranial Aneurysm.** The optic nerve may be compressed by an aneurysm arising from either the internal carotid or the anterior cerebral arteries. Visual loss is progressive but it may be reduced gradually or with relative rapidity. Other symptomatology may be absent in the early stages. Visual fields may show an irregular loss in the inferior half of the field, or there may be a beginning nasal hemianopsia. Roentgenograms may offer little assistance, and a diagnosis may not be possible until additional signs occur as a result of extension. Concurrent with increased failure of vision, extension of the process may cause pressure on the ophthalmic division of the fifth nerve. The resulting severe pain in the eye, forehead, and side of the nose accompanying the loss of vision may lead to a false diagnosis of accessory-nasal-sinus disease with optic neuritis. Sometimes the

severity of the pain and its distribution to the region supplied by one branch of the fifth nerve suggest tic douloureux. Anomalies of rotation may occur when the third, fourth, or sixth nerve is involved. The symptoms other than the visual are characteristically of an intermittent character. These may arise from

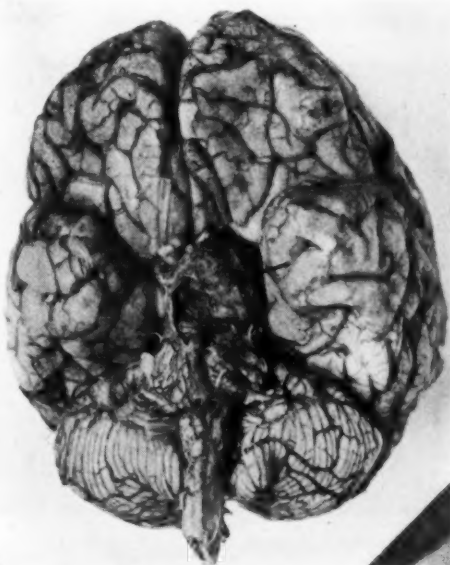


Fig. 1 (Leinfelder). Aneurysm of circle of Willis pressing on left optic tract and nerve. The third, fifth, and sixth nerves were also affected.

intermittent swelling of the aneurysmal sac or from bleeding into adjacent regions. It is often difficult or impossible to make a clinical diagnosis of cerebral aneurysm. A vascular tumor should be suspected in the older patient who has arteriosclerosis, a nasal hemianopsia, and progressive signs of irritation or compression of the second, third, fourth, fifth, and sixth cranial nerves (fig. 1). In the face of progressive signs and symptoms, an exploratory craniotomy may be required to establish definite diagnosis.

The acute onset of marked loss of vision may be the result of hemorrhage

in the region of the chiasma with extension of the hemorrhage to the vaginal sheath of the optic nerve. Hemorrhage may result from spontaneous or traumatic rupture of a normal vessel, a small aneurysm, or of a sclerotic meningeal vessel.

*Suprasellar Cyst.* These slow-growing neoplasms may in their early stage produce no signs nor symptoms except those

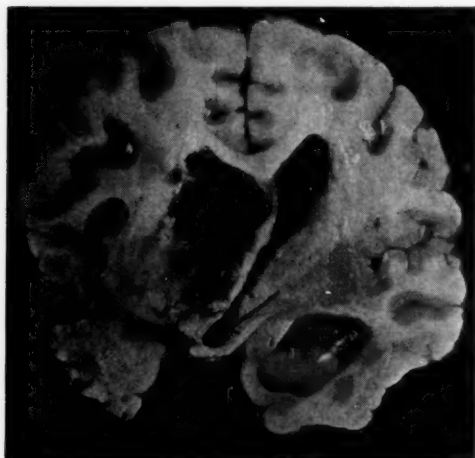


Fig. 2 (Leinfelder). Ventricular shift to right, internal hydrocephalus, and pressure on the optic chiasm by dilated third ventricle. Ependymoma of the left lateral ventricle.

due to changes in the visual fields. Bitemporal hemianopsia is ordinarily associated with suprasellar cysts, but in the event that the cyst has grown more to one side than the other, visual changes will be more pronounced in one eye. The loss of acuity may be due to a central scotoma or to a temporal hemianopsia that has advanced beyond the midline on one side. Differential diagnosis may be extremely difficult. Choked disc usually develops, and erosion of the sella with calcium deposition eventually takes place. Choked discs were not present in two cases seen by the author, and in one of these the visual acuity gradually dimin-

ished, more rapidly in one eye, incident to an increasing incongruous bitemporal hemianopsia. Because of developing optic atrophy, an exploratory operation was made at which a suprasellar cyst was exposed.

*Internal Hydrocephalus.* Internal hydrocephalus, due to obstruction of the aqueduct of Sylvius or foramen of Magendi, or due to tumors in the posterior portion of the third ventricle, causes a bulging of the floor of the third ventricle in the region of the infundibular and optic recesses. The usual symptoms under such conditions are a bitemporal hemianopsia because of pressure on the optic chiasma, and choked discs as a result of the increased intracranial pressure. Not all cases, however, show papilledema, and the only ocular findings may be diminished visual acuity in one eye accompanied by an asymmetrical bitemporal hemianopsia. Asymmetric hemianopsia results from unilateral pressure on the chiasma with the result that both crossed and uncrossed fibers are affected on one side while only the crossing fibers are compressed on the other. This more frequently occurs when an obstruction of the aqueduct results from a shift of the ventricular system to one side, as occurs in many cerebral tumors. Unilateral loss of vision with optic atrophy, and slight choked disc on the opposite side were observed by the author in a girl with an ependymoma of the lateral and third ventricles (fig. 2).

*Frontal-Lobe Tumors.* Foster Kennedy<sup>3</sup> was the first to emphasize the importance of unilateral loss of vision from "retrobulbar neuritis" in expanding lesions of the frontal lobe. These neoplasms were usually located in the lower portion of the frontal lobe and exerted pressure upon the optic nerve and chiasma. Foster Kennedy believes that a

central scotoma develops because the macular fibers are more delicate and of greater susceptibility to pressure. In our experience at the University Hospitals this syndrome has been infrequently seen, but incomplete homonymous hemianopsia, greater on one side than the other, has been of more common occurrence. This field change is the result usually of direct pressure upon the optic tract by the tumor mass. Occasionally indirect pressure on the tracts results from displacement of brain tissue by a tumor in the frontal or parietal lobes (fig. 3).

**Hysteria.** The ocular manifestations of hysteria are manifold, and visual disturbances may occur with or without other neurological evidence of the disease. Unilateral loss of vision is not an uncommon complaint. Complete or partial loss is usually sudden, and the patient can tell exactly when it occurred. The acuity of vision is usually constant, but variations may occur with different examiners and on different days. Perimetric fields show a concentric contraction that is as completely contracted for small targets as for large. A central scotoma, a peripheral contraction, or both may be elicited. Ophthalmoscopic examination reveals no evidence of ocular disease.

In hysteria, the signs and symptoms are usually consistent, since the patient is not aware of the functional nature of the disease. This is directly opposed to the situation in malingering, in which case the patient is cognizant of the absence of pathology. We must recognize on a clinical basis that there is often difficulty in clearly differentiating between malingering and hysteria, but fundamentally the two diseases are decidedly separate entities. The hysterical patient often responds to suggestion with resulting improvement in vision, and other signs and symptoms of hysteria can fre-

quently be elicited. The patient is usually but not invariably a young adult female, in whom a history of psychic trauma can be obtained. Frequently there is calm and unconcern rather than nervous overactivity and hyperexcitability. The diagnosis is usually not difficult if the patient is studied thoroughly.

**Infrequent Causes.** Infrequently a unilateral loss of vision may be due to the

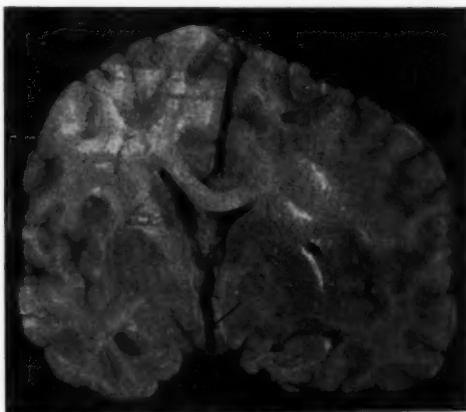


Fig. 3 (Leinfelder). Ventricular shift to left and internal hydrocephalus with well-dilated third ventricle. Tumor was on medial surface of frontal lobe.

early manifestations of neurosyphilis, neuromyelitis optica, optochiasmic arachnoiditis, or metastatic neoplasms. In chronic syphilitic meningitis, occasionally one may find a central scotoma as the early symptom of a beginning optic atrophy. A concentric peripheral contraction of the visual field may be the only accompanying sign, for in the early stage the nerve head may have a normal appearance. The presence of other signs and symptoms of syphilis of the central nervous system and the positive spinal-fluid reactions will lead to a correct diagnosis.

Most frequently optochiasmic arachnoiditis and neuromyelitis optica affect both eyes, but in either disease one eye

may remain normal for several days after the onset of symptoms. Neuromyelitis optica is characterized by a retrobulbar neuritis of acute onset with marked loss of vision, pain in the orbit, fever and malaise, and signs of disease of the spinal cord. The occurrence of peripheral signs of a myelitis in a case of retrobulbar neuritis is pathognomonic of neuromyelitis optica. In optochiasmic arachnoiditis, the diagnosis is more difficult. There is a gradually increasing loss of vision in which one eye may precede the other. A central scotoma on one or both sides with bitemporal field cut is a rather characteristic field change. Choked disc and optic atrophy may develop with one side being more marked than the other. The spinal fluid is usually normal, for the inflammatory process is well localized in the region of the chiasm. Positive diagnosis usually cannot be made except at operation.

Diagnosis of a lesion due to a metastasis of a malignancy depends to a great extent upon the recognition of the primary tumor. In addition to unilateral loss of vision, a neoplasm secondarily in-

volving the base of the brain can cause multiple signs and symptoms by pressure upon any of the cranial nerves.

#### CONCLUSIONS

Unilateral loss of vision should in each instance call to mind the possibility that the local condition is but a manifestation of disease of the central nervous system. In order to establish an etiologic diagnosis, it may be necessary to observe the patient repeatedly over a period of weeks. During this time, careful search should be made for new evidence of localization or extension of the process, by frequent thorough neurologic examinations, and by attempts to elicit variations and progressions in the visual fields. Special care should be observed to demonstrate early signs of compressions of the third, fourth, fifth, and sixth nerves, for involvement of these structures is extremely suggestive of a lesion at the base of the brain. Roentgenograms may serve to locate or identify the lesion, but occasionally a diagnosis cannot be made without exploratory operation of the base of the brain.

#### REFERENCES

- <sup>1</sup> Cushing, H. The chiasmal syndrome of primary optic atrophy. *Arch. of Ophth.*, 1930, v. 3, p. 505.
- <sup>2</sup> Adie, W. J. The etiology and symptomatology of disseminated sclerosis. *Brit. Med. Jour.*, 1932, v. 2, p. 997.
- <sup>3</sup> Kennedy, Foster. Retrobulbar neuritis as an exact diagnostic sign of certain tumors in the frontal lobes. *Amer. Jour. Med. Sci.*, 1911, v. 142, Sept., p. 355.

## ASTHENOPIA DUE TO VITAMIN-A DEFICIENCY\*

FREDERICK C. CORDES, M.D. AND DAVID O. HARRINGTON, M.D.  
*San Francisco*

The following report presents a clinical survey of cases of asthenopia in which the symptoms were apparently due to vitamin-A deficiency.

A great deal of work has been done on the vitamins during the last 10 years, and the literature contains many articles on the subject. Most of our knowledge has come from laboratory workers, and the clinician often has a hazy idea of the subject.

Yudkin<sup>1</sup> has defined vitamins as substances that are indispensable in the maintenance of the health and normal growth of all living cells. "The vitamins do not furnish energy, as do the proteins, fats, and carbohydrates, but they may be classified with the hormones and the inorganic elements such as iodine, copper, and manganese. These substances, according to some biochemists, may be looked on as stimulating or conditioning agents of cell metabolism, perhaps as a type of biochemical catalyzer."

As Mathews<sup>2</sup> points out, vitamin A was originally called fat-soluble A by McCollum, its discoverer, because it occurs in cream, the fat of milk, and in the oil from yolk of eggs. In this way he distinguished it from vitamin B which also occurred in milk and eggs but was water-soluble. This latter vitamin he designated as water-soluble B. These vitamins are now called simply A and B. In 1919 Steenbock<sup>3</sup> noted some correlation between the vitamin-A effect of certain vegetables and the amount of the yellow pigment (carotene) present in these foods. Von

Euler<sup>4</sup> in 1928 demonstrated that carotene could replace vitamin A in the diet. The name carotene has been applied to the four provitamins called alpha, beta, and gamma carotene and kryptoxanthin. All four are yellow pigments of plants. The body, however, cannot form vitamin A from the common yellow plant pigment xanthophyl. Vitamin A is colorless, has been isolated in almost pure form, but has never been synthesized. Carotene, as stated above, is intensely yellow.

### SYMPTOMS AND SIGNS OF VITAMIN-A DEFICIENCY

A deficiency of vitamin A in the diet or interference with its absorption produces avitaminosis A. In this country the cases are usually very mild. There are certain symptoms and signs that are now associated with this deficiency: (1) night blindness (nyctalopia, or hemeralopia) and xerophthalmia, Bitot's spots, opaque whitish deposits in the scleral conjunctiva, are the most characteristic signs. (2) keratinization of epithelial cells in various parts of the body. (3) Cornification and eruption of the skin with papular and pustular lesions. (4) Retarded growth, weakness, and loss of weight. (5) Increased susceptibility to infections of mucous membranes. It is generally accepted that in adults and older children night blindness is almost always the earliest sign of the disease.

In this country the ocular manifestations of the deficiency are almost limited to this early stage.

A great deal of work has been done in relation to night blindness. One of the best articles on this subject is by Jeghers,<sup>5</sup> who has made an excellent review of the entire subject of vitamin-A deficiency.

\* From the Division of Ophthalmology, University of California Medical School. Read before the Eye, Ear, Nose, and Throat Section of the California Medical Association, Del Monte, May 1, 1939.

#### PHYSIOLOGY AND BIOCHEMISTRY OF VITAMIN-A

The vitamin-A content of our diet comes from two distinct sources: carotene from the plant kingdom, and true vitamin A from certain animal sources. The body is unable to synthesize either. Being fat-soluble substances, both carotene and vitamin A are absorbed by the lacteals of the intestine, become intimately associated with the chyle, and enter the general circulation through the thoracic duct, according to Drummond, Bell, and Palmer.<sup>6</sup> No change takes place in either during the absorption process. Vitamin A is stored directly in the liver, while carotene, as demonstrated by Olcott and McCann,<sup>7</sup> is converted into vitamin A before it is stored. Mendel<sup>8</sup> showed that the liver plays an important part in the regulation of the concentration of vitamin A in the body. Certain physical conditions increase the need of vitamin A or retard its absorption or storage. These conditions have been summarized by Jeghers<sup>5</sup>: "Fever,<sup>9</sup> rapid growth,<sup>10</sup> general infection,<sup>11</sup> elevated basal metabolic rate,<sup>12</sup> and pregnancy,<sup>13</sup> all increase the metabolic need for vitamin A. Lack of bile,<sup>14</sup> or pancreatic secretion,<sup>15</sup> changes in the gastrointestinal mucosa,<sup>16</sup> and disturbances of motility of the gastrointestinal tract,<sup>11</sup> all prevent or hinder the proper absorption of this vitamin. Liver disease,<sup>11</sup> prevents the proper storage of vitamin A as well as the conversion of carotene to vitamin A." From this it is apparent that even with a so-called adequate diet there may still be a deficiency. It seems to matter little in the diet whether the vitamin is present in the form of vitamin A or carotene.

#### NATURAL SOURCES OF VITAMIN A

Booth and Hansen<sup>17</sup> list the natural sources of vitamin A in the order of their potency.

*Vitamin A.* Halibut-liver oil is the richest source while burbot-liver oil ranks next followed by cod-liver oil and liver. Whole milk supplies more than any other single food, but large amounts are also found in butter, egg yolk, and animal fats (beef and mutton).

*Provitamins.* In this group apricots are the richest plant source while large amounts are also found in spinach, carrots, and chard. Smaller amounts (one sixth as much as in butter) are found in green beans, green peas, Brussels sprouts, lettuce, tomato, yellow squash, sweet potato, and pumpkin. Butter contains both vitamin A and carotene.

According to Sandler,<sup>18</sup> storage, bleaching, oxidation, and some types of processing may reduce the vitamin content of the food. Most authorities, however, agree that very little vitamin A is lost during the processes of commercial canning or home cooking.

#### RELATION OF VITAMIN A TO THE RETINA

It has long been known that the rods in the retina contain a purple matter called visual purple or rhodopsin. It is very sensitive and becomes bleached and inactive when exposed to light. When the normal eye returns to darkness the visual purple is very rapidly regenerated. Loss of visual purple produces a loss of power of seeing faint sources of light.

The work of Friderica and Holm,<sup>19</sup> Tansley,<sup>20</sup> Yudkin,<sup>21</sup> and others demonstrated the presence of either vitamin A or carotene in the retina. Wald<sup>22, 23</sup> was able to demonstrate that the substance was vitamin A rather than carotene and by his later work<sup>24</sup> was able to clarify the relationship between vitamin A and visual purple.

The consensus of opinion at present is that vitamin A is picked out of the blood by the retina, presumably first by the pigment layer and later by the rods and

combined with protein to produce the visual purple (rhodopsin). When exposed to light this changes into visual yellow and retinene. The visual yellow and perhaps the retinene change partly into vitamin A and partly into degradation products which pass out in the blood. The vitamin A is recombined with protein and the process is again repeated. During this cycle a certain amount of these substances is lost, necessitating a constant supply of vitamin A from the blood stream. The nature of the chemical changes is as yet undetermined. It is also, at present, not understood how the bleaching of the visual purple sets up an impulse in the optic nerve.

#### TESTS FOR VITAMIN-A DEFICIENCY

In 1934 Jeans and Zentmire<sup>25</sup> introduced the Birch-Hirschfeld photometer into this country as a means of measuring minor degrees of vitamin-A deficiency.

A few years ago an American firm perfected a new photometer called the "Bio-Photometer."\* It operates on the principle of measuring the minimum light visible after the eye has been exposed to a bright light. The instrument has the advantage of measuring directly in millifoot-candles the minimal light intensity that is visible to the eye. There are also other methods of determining vitamin-A deficiency, but recently Jeans, Blanchard, and Zentmire<sup>26</sup> were able to show that the Bio-Photometer is more sensitive than other methods in picking out borderline cases of deficiency. In the cases reported here the Bio-Photometer was the instrument used to determine the presence of deficiency, and the normal curve determined by Jeghers was used as the standard.

\* Manufactured by Frober-Faybor Company, Cleveland, Ohio.

#### ASTHENOPIA DUE TO EXCESSIVE LIGHT

It is well known that there are patients who appear to be on a normal vitamin-A diet but who, as the result of working under excessive light or conditions of glare, have asthenopia. The usual symptoms are photophobia, pain, and fatigue of the eyes upon use, headache and momentary attacks of blurring of vision toward the end of the day. When the patients are away from their work for a few days the symptoms disappear. The Bio-Photometer test usually shows a low reading, and the patients are helped by increasing their vitamin-A intake.

Typical of this type were: an artist whose models sat under a strong light; a service station attendant in one of the warm valley towns, whose station was surrounded on three sides by white walled buildings; and an artist who painted the film of animated cartoons, the work being done over a very bright light box.

The work of another patient, assistant curator in a museum, consisted of repairing paintings, restoration work of various types, together with a good deal of work on white. His rooms had very light-colored walls and were directly under a large skylight, so that a great deal of light was present. The patient complained of headache upon use of the eyes, pain, vision "coming and going" after three o'clock in the afternoon, inability to do any work at night, and, upon questioning, gave the symptoms of night blindness. Prescription of glasses and treatment of a low-grade chronic catarrhal conjunctivitis gave some relief. The remainder of the ocular examination and general physical examination was negative. A Bio-Photometer test was not available, but because of the symptoms of night blindness the patient was given 30,000 units of carotene daily. At the end of two weeks the symptoms of asthenopia

had disappeared, although he still had some symptoms of night blindness. He was soon able to use his eyes all day without symptoms and for the first time in a number of years was able to work at night.

This case suggested the possibility of certain cases of persistent asthenopia being associated with insufficient vitamin A in the diet. When the Bio-Photometer test became available it was decided to study a series of these cases to determine whether or not asthenopia at times is related to vitamin-A deficiency.

#### ASTHENOPIA IN VITAMIN-A DEFICIENCY

This clinical report is based on the study of 82 private patients with persistent asthenopia in whom, as indicated by the Bio-Photometer, there was a deficiency in vitamin A. Therapy was instituted only after sufficient time had elapsed to have obtained all possible relief from the correction of the usual causes of asthenopia. In some of the later cases the symptoms were so suggestive of vitamin-A deficiency that the Bio-Photometer reading was taken at the time of the initial examination; in the majority, however, it was obtained when the patient returned, after a month or longer, complaining of persisting symptoms.

*Sex and Age.* There was a marked predominance of females in this series of cases, only 29 percent being males. The age group was between 13 and 78 years, with the average age at 45.85 years. It is interesting to note that 51 percent of the patients were in the presbyopic age.

*Symptoms.* As Jeghers<sup>27</sup> has pointed out photophobia and sensitivity to glaring lights frequently accompany avitaminosis A, so that it is not surprising that 69 percent of the patients complained of being light sensitive.

Aside from this photophobia there

were certain other symptoms which disappeared with therapy that were found so consistently among these patients as to suggest a fairly typical symptom complex. The eyes ached after use for a short time; while reading the print blurred momentarily ("comes and goes") and there was difficulty in reading over 10-15 minutes at a time, especially at night. These were the symptoms met with most frequently. In 16 percent of the patients there were indefinite symptoms such as being conscious of the eyes and uncomfortable when using them. Eleven percent complained of headache or blurring while driving, and in approximately the same number there was difficulty when viewing the movies. Seven cases had marked symptoms of asthenopia to the extent that they were unable to use their eyes. As we shall see later, it is this group that primarily accounts for the failures in treatment. In a few instances headache upon use of the eyes was the principle complaint.

TABLE 1

SUMMARY OF SYMPTOMS DUE TO AVITAMINOSIS A  
(Persisting after correction of usual causes)

Photophobia	69%
Eyes ache after use for short time	48%
Difficulty in reading over 15 minutes, especially at night	37%
Momentary blurring while reading	31%
Indefinite symptoms of asthenopia	16%
Headache or blurring of vision while driving	11%
Symptoms while attending movies	10%
Marked symptoms of asthenopia	7%
Dizziness	1 case
After image	1 case
Persistent chronic conjunctivitis present	26%

One patient of 23 years (Case 62) had among other symptoms a persistent dizziness which disappeared under treatment only to reappear after carotene had been discontinued for a time. With subsequent return to therapy it again disappeared.

A young man of 34 years (Case 11) had a bluish afterimage that was persistent but disappeared under treatment.

Four patients (cases 30, 39, 59, and 80), all of whom were completely relieved of their symptoms, had had difficulty "for years" and had been to many oculists.

It is interesting to note that 22 patients (26 percent) had a chronic persistent conjunctivitis.

*Bio-Photometer readings.* The low point of the Bio-Photometer readings, taken before therapy was instituted, ranged between 0.7 and 4.2 millifoot-candles, the average being 2.09 mft-c. Accepting Jegher's normal of 0.75 mft-c, the average of 2.09 can be considered very low.

After treatment and before discharge the average reading had been brought up to 0.9 mft-c. There were some patients whose symptoms disappeared and in whom the Bio-Photometer reading improved but never approached normal. In other instances, to be discussed later, it was necessary to maintain the level above "normal" to relieve symptoms (Chart 1).

*Night blindness.* In only 22 percent of the cases was it possible to obtain a history of any degree of night blindness. This was surprising in view of the fact that the average Bio-Photometer reading for the group was 2.09 mft-c, and would seem to indicate that many individuals have a mild degree of night blindness of which they are unaware. This agrees with the opinion of a number of writers<sup>5, 16, 20</sup> that milder degrees of avitaminosis A are more prevalent than has been suspected.

The relation of vitamin-A deficiency to difficulty of driving an automobile at night was illustrated by three rather unusual cases. Case number 66 was of a male of 46 years who had a Bio-Photometer reading of 4.2 mft-c. This caused such a marked night blindness that he had given up driving his car at night.

The second patient (case 65) a male of 38 years, whose Bio-Photometer reading was only down to 1.9 mft-c, had marked difficulty driving at night, while the third patient (case 50), whose reading was 1.75 mft-c, experienced similar difficulties. That the first case should have marked symptoms is readily understood because of the extremely low reading but it was somewhat surprising that the last two individuals with rather mild avitaminosis A should complain so severely of trouble in night driving. In all three instances the symptoms disappeared under treatment.

*Diet and Physical abnormalities.* In this series 31 percent gave a history of dietary deficiency. Thirteen of these patients had chronic gastrointestinal disease, in most instances chronic colitis, and were on so-called bland or smooth diets. In four instances there was chronic gall-bladder disease with its dietary regulations. One patient was allergic to many foods, couldn't drink milk, was "horried" at the thought of vegetables, and as a result was on a markedly deficient diet. Her physician stated that he "doesn't see why she doesn't have scurvy." A woman whose husband, a ship's radio operator, was gone for long periods of time showed a marked avitaminosis A. During her husband's absence the patient, who lived alone in a small apartment and didn't want to cook for only herself, lived upon poorly selected canned foods. In several instances the deficiency was the result of a poorly planned reducing diet. Two patients, who gave a history of excessive alcohol over a long period of time, had very low Bio-Photometer readings. In these cases the hypovitaminosis B associated with alcoholism and characterized by loss of appetite may have been indirectly responsible for the vitamin-A deficiency by causing a restricted intake of food. In addition it is recognized that

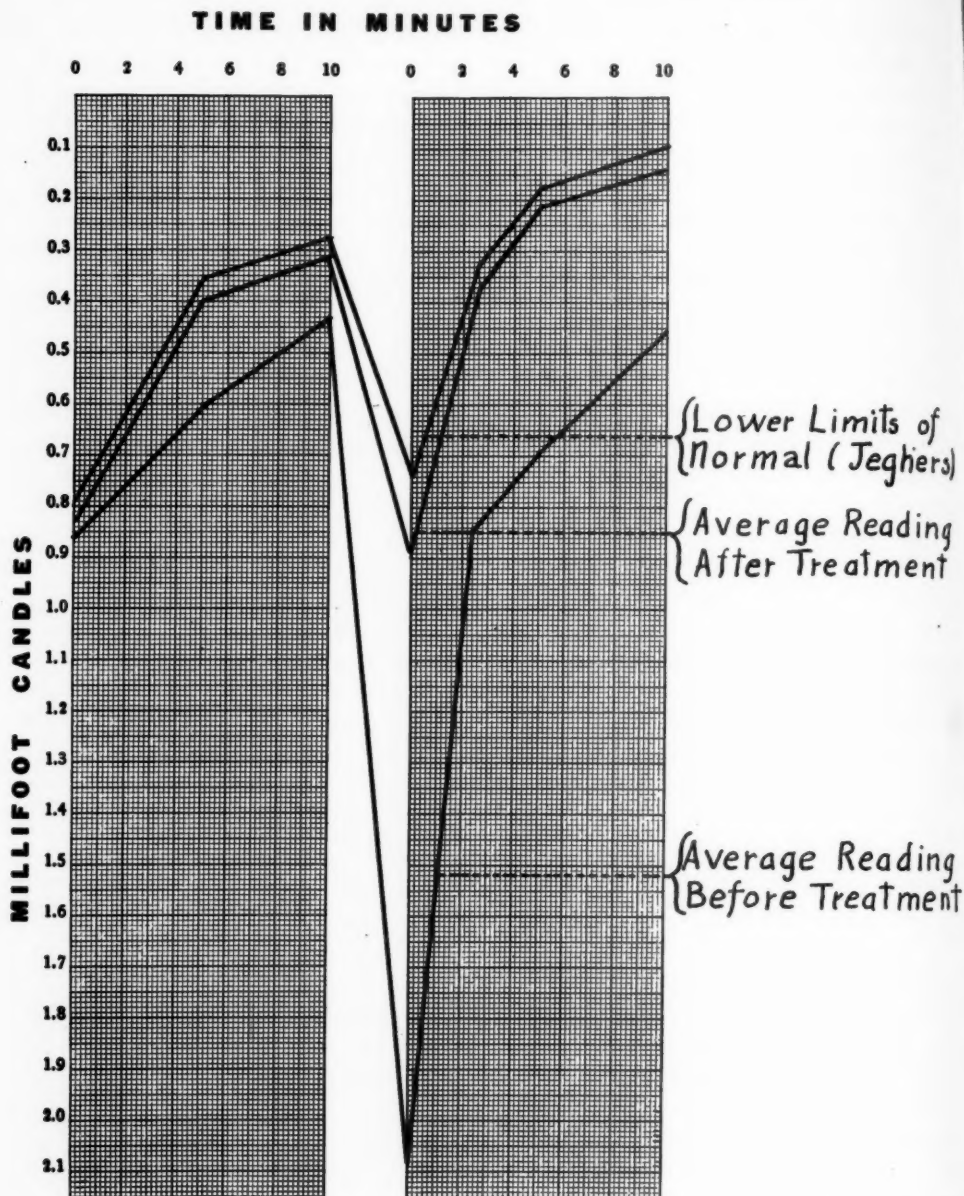


Chart 1 (Cordes and Harrington). Average Bio-Photometer readings in vitamin-deficiency cases.

prolonged deficiency in any one vitamin may bring about a shortage of others.

Other physical conditions which may have had a bearing were a longstanding chronic sinus disease, chronic arthritis, and chronic bronchitis. Two patients

were in the menopause, from which they were receiving rather marked disturbances that probably accounted for their abnormal diet.

Aside from the 31 percent noted above, the remainder of the patients seemed to

be on an adequate diet. Several patients lived in areas where there is a good deal of glare and heat in the summer and this must be considered as a possible factor in the avitaminosis A.

*Refractive errors.* The type of refractive error has no apparent relationship to vitamin-A deficiency. In this group 66 percent were hyperopic and of these the majority had compound hyperopic astigmatism. As already stated, over half of the patients were in the presbyopic age.

*Therapy.* Coward<sup>28</sup> found no significant difference between the efficiency of absorption by the rat of vitamin A of cod-liver oil, the vitamin A and carotene of butter, and the vitamin A artificially added to margarine. Wilson, Das Gupta, and Ahmad<sup>29</sup> showed that carotene of green vegetables is well absorbed by man, especially when fats are present. From this it is apparent that there is no essential difference whether vitamin A or carotene is used.

In this study S.M.A. carotene in oil capsules, which were graciously furnished by the manufacturer, were used. These capsules are standardized in U.S.P. units of vitamin A. This unit consists of the amount of vitamin A in milligrams producing the growth promoting and antixerophthalmic activities in vitamin-A depleted rats equal to that of 0.6 gamma of International Standard beta carotene. If other forms of vitamin A are used they should be in the form of concentrates such as Super-vitamin-A concentrate (Upjohn) in which each capsule contains 8,500 U.S.P. units of natural vitamin A, together with approximately 100 units of vitamin D dissolved in a vegetable oil. Using cod-liver oil as a source it would require about 15 teaspoons a day to equal 30,000 units of vitamin A. In addition to obvious objec-

tions there might be some possibility of hypervitaminosis D with its resultant increased calcification of tissues, particularly the cardio-vascular system.

In the majority of cases 30,000 units (one 10,000 unit capsule t.i.d.) were given daily for a period of one month and then the Bio-Photometer reading was repeated. With this and the subjective symptoms as a guide the carotene was continued or reduced in amount until an apparent balance was obtained. With complete disappearance of symptoms some patients did not return for further observation. There were two patients who were unable to take carotene because of the resultant gastric distress. It is interesting that in the majority of cases some improvement of the symptoms was noted within a week or 10 days from the time therapy was started.

A word of caution concerning excessive use of carotene: If it is absorbed faster from the intestinal tract than the liver can convert and store it, this surplus causes a yellow color (carotinemia) to appear in the body. It is not dangerous and disappears promptly when the carotene intake is reduced. In case 39 a definite carotinemia developed which disappeared promptly when the amount of carotene was reduced, while in case 72 there was a definite slight yellow discoloration of the hands.

*Results.* In this series 79 percent of the patients had complete relief from their symptoms following carotene therapy, 12 percent received partial relief, while in 9 percent there was no improvement.

The following two histories illustrate the average typical case that was improved by therapy.

Case 40. Mrs. A. B., aged 63 years, had persistent symptoms of photophobia, fatigue of eyes, and headache when doing near work and was generally unhappy

regarding her eyes. Conjunctivitis had been persistent and resistant to treatment. Her general physical condition was good and her diet seemed adequate. The Bio-Photometer reading was 2.2 mft-c. On August 6, 1937, the patient was given 30,000 units of carotene daily. At the end of one month she was entirely comfortable, was able to read, and no longer had headache. Her conjunctivitis had almost disappeared. The Bio-Photometer reading was 0.7 mft-c. The patient has remained comfortable up to the present time (20 months) by continuing 10,000 units of carotene daily.

Case 59. Mrs. C. C., aged 66 years, had been a patient for a number of years and during this time had had persistent photophobia and mild chronic catarrhal conjunctivitis. She had had trouble reading at night for a period of many years and at times while reading, she said, the vision "comes and goes." Movies had always bothered her. The patient had a history of long-standing chronic colitis, but appeared to be on an adequate diet. The Bio-Photometer reading was 1.3 mft-c. The patient was put on 30,000 units of carotene daily. At the end of a week there was a definite improvement, and at the end of a month she stated that she was perfectly comfortable and that her eyes were the best they had been in a long time. The Bio-Photometer reading was 0.65 mft-c. After two months the patient discontinued carotene with a subsequent drop of her reading to 1.1 mft-c. With this her symptoms returned in a mild form but disappeared when she was again given carotene. This patient has been kept under observation for 18 months and has been kept comfortable by the continued use of 10,000 units daily.

In some instances the results were spectacular, as illustrated by Case 74.

Mrs. C. J. B., aged 58 years, was first seen in 1936, complaining of photophobia, marked fatigue, and aching of the eyes after close work together with symptoms after driving or going to the movies. In addition to her refractive error there was a rather marked chronic catarrhal conjunctivitis. After refraction and treatment of the lids the patient obtained only partial relief. She was not seen again until August, 1938. In the meantime she had been to several ophthalmologists who had changed her glasses and given her lid treatments but without improvement in her condition. The complaints were essentially those of her 1936 visit, and the conjunctivitis was still present. The patient's general physical condition was apparently excellent and she seemed on an adequate diet. The Bio-Photometer reading was 2.2 mft-c. The patient was given 30,000 units of carotene daily. A month later she stated that she was completely well, was able to read as much as she pleased, could go to the movies without symptoms; driving no longer bothered her and she was very happy to be able to do as she wanted without thinking of her eyes. The patient has continued to be free from symptoms on 10,000 units daily. The persistent conjunctivitis has entirely disappeared.

In the group that obtained partial relief there was in each case some chronic physical condition that was undoubtedly a factor. Illustrative of this group is

Case 39. Miss M. B., aged 39 years, a teacher, gave a long history of eye trouble including photophobia, blurring of vision, headache, difficulty in reading at night, and a persistent conjunctivitis. She had a great deal of stomach trouble for which she was on a diet that included very few vegetables, little milk or cream. The Bio-Photometer reading was

down to 2.15 mft-c. The patient was given carotene therapy (30,000 units daily); under this the photophobia and blurring of vision disappeared and there was some improvement in her conjunctivitis. The headache and difficulty of reading at night, however, persisted. Because of the tendency to develop carotinemia the amount of carotene had to be reduced and because of her stomach condition it was not possible to give her sufficient vitamin A to bring the reading over 1.9 mft-c.

A review of the failures is not without interest. In this group, the patients in cases 4 and 28 had typical symptoms, low readings, and no apparent physical or mental abnormalities. Treatment which improved their Bio-Photometer readings to normal failed to give any relief from symptoms.

Three of the patients (cases 16, 22, 64) were single women in their fifties who had had marked symptoms of asthenopia and photophobia for years. In all of them there was a history of indefinite physical complaints for which their physicians could find no cause. The Bio-Photometer readings were very low in all three and under treatment showed marked improvement (to normal in case 16) but without any relief from their symptoms. Two of them were convinced that nothing could help them. It seems fair to assume in these cases that the vitamin-A deficiency was only a small factor in the general picture.

In case 10, the patient, a woman of 59 years, had marked symptoms associated with the menopause. Even though therapy improved her Bio-Photometer reading from 2.5 to 0.7 mft-c, there was no improvement in symptoms except for some relief from her photophobia.

Of particular interest was the patient in case 20, a woman of 80 years, who

had the typical symptoms of asthenopia associated with vitamin-A deficiency. She was in poor physical condition, being very anemic, and had a history of chronic gastrointestinal disease over a period of many years. Treatment for a period of seven months gave no relief. Her first Bio-Photometer reading was 3.2 mft-c, and even on 40,000 units of carotene daily was brought above 2.5 on only one occasion. During the short time she was up to 1.9 mft-c, there was a slight improvement in her symptoms. In view of the gastrointestinal history, this patient seems to illustrate the type of avitaminosis A in which changes in the gastrointestinal mucosa or disturbances of motility of the gastrointestinal tract prevent or hinder the proper absorption of this vitamin.

*Comments.* Aside from improvement of the asthenopic symptoms under carotene therapy certain observations were made that warrant further comment.

In the patients under treatment 46 percent had complete relief from their symptoms even though the Bio-Photometer reading was still below normal. On the other hand there were a number of patients with normal Bio-Photometer readings whose symptoms were typical of vitamin-A deficiency. As a result, these patients were put on carotene therapy with ultimate relief and with a reading above normal. In case 52, which is typical of this group, the reading was 0.7 mft-c, and the patient was free from symptoms when under carotene. The reading increased to 0.25 mft-c. When carotene was discontinued the Bio-Photometer value dropped to the so-called normal, with a return of the symptoms which again disappeared when therapy was resumed.

In about 50 percent of the patients it

was necessary to continue carotene even though the patients were instructed to increase the vitamin-A content of their diet, as the symptoms returned when the carotene was discontinued, and the Bio-Photometer readings dropped. Recently cases have been kept under observation until the amount of carotene necessary to maintain a balance has been determined. In most instances 10,000 units daily was sufficient to accomplish this.

The relation of avitaminosis A to certain conditions of the skin and mucous membranes is well recognized and was illustrated in several instances in this series.

L. K. (case 24), a girl of 13 years, on a reducing diet, had in addition to her asthenopic symptoms, a marked acne that had been most resistant to treatment. After she had been on carotene for two months the skin condition had entirely cleared. W. C. (case 61), a male of 32 years, had a marked eczema of the hands which had been under treatment for a number of years but without improvement. His Bio-Photometer reading was very low (3.5 mft-c) so that he was put on 40,000 units of carotene daily. At the end of a month the eye symptoms had disappeared, the chronic skin condition was cleared, and the patient volunteered that his hair had stopped falling out and was no longer as dry as it had been.

Three patients (cases 39, 81, 82) stated that there was a marked improvement in their chronic nasal condition. One volunteered that the "right side of the nose is clear and open for the first time in 10 to 12 years."

In two instances (cases 68, 80) the therapy apparently was of marked benefit to the gums. One of the patients stated that the gums had stopped bleeding and were not spongy for the first time in years. After she had been on treatment for two months she saw her dentist who

commented on the improved condition of her gums and asked what had been done to produce such a marked improvement.

In 22 cases there was a persistent chronic catarrhal conjunctivitis that in 18 disappeared spontaneously when the patients were given carotene. It was rather noteworthy that in a high percentage of cases with very low Bio-Photometer readings a chronic conjunctivitis was present.

Case 15 is of interest because of the fact that the symptoms were controlled for 14 months by the daily use of 10,000 units of carotene. At the end of this time the patient went into the menopause and with this her symptoms returned but again disappeared when the daily intake was increased to 20,000 units of carotene.

A detailed discussion of case 26 is warranted because of several unusual features. Mr. F. H. E., aged 71 years, had a chronic simple glaucoma that was controlled by miotics for a number of years, but in 1928 the excitement of having his home burglarized precipitated a sharp increase in tension that required surgery. While in the hospital he developed a bilateral acute glaucoma for which his ophthalmologist performed a bilateral iridectomy. This procedure has controlled the tension since that time. The field of vision was markedly contracted in one eye and concentrically contracted in the other. In April, 1938, the patient complained of rather marked night blindness and that the eyes ached upon use and fatigued easily and that he could read only a very short time at night when the print blurred. He had a very troublesome photophobia, especially on looking out of a train window, and was unable to ride in a car at night because of the great discomfort. The Bio-Photometer reading was 2.3 mft-c. The patient was put on 60,000 units of carotene daily. At the end of 11 days there was an im-

improvement in symptoms and the reading had improved to 1.4 mft-c. The condition gradually improved until a normal Bio-Photometer reading was obtained and held by 20,000 units daily. The patient's symptoms have entirely disappeared, and one year after treatment was started he continues to be comfortable. This case is particularly noteworthy as, with a history of glaucoma, contracted fields, and bilateral iridectomy one would expect at least some of the symptoms complained of, and yet they were so typical of avitaminosis A that we had a Bio-Photometer test made. The result suggests that possibly some of the symptoms complained of after glaucoma surgery, particularly iridectomy, may at least in part be due to lack of vitamin A.

Carotene was tried in one case of bilateral chronic simple glaucoma with some contraction of fields in which the tension was controlled by miotics. The patient complained of night blindness and, as was to be expected with small, contracted pupils, received no relief from the use of carotene.

#### SUMMARY

This report presents a review of 82 cases of persistent asthenopia in which it is felt vitamin-A deficiency, as judged by the Bio-Photometer, was the causative factor. The Bio-Photometer readings varied between 0.7 and 4.2 mft-c, the average being 2.09. In this group a history of night blindness was obtainable in only 22 percent of the cases. In 30.5 percent there was an apparent deficiency in diet, while 17 percent of the patients gave a history of chronic gastrointestinal disease, usually chronic colitis.

These patients were treated with carotene in oil, the average dose being 30,000 units daily. Of the patients on this therapy 79 percent obtained complete

and 12 percent partial relief from their symptoms. In the majority of patients it was necessary to continue small doses of carotene to maintain a balance. Forty percent of the cases were observed for a period of over six months and 20 percent between one and two years.

The symptoms that persisted after the usual causes of asthenopia had been corrected were consistent enough to suggest the following symptom complex as being typical of vitamin-A deficiency:

The patients complained of photophobia associated with pain and rapid fatigue of the eyes upon use, especially at night; difficulty in reading for longer than 15 to 20 minutes, with the print at times blurring momentarily. Driving and the movies caused headache and blurring in a fairly high percentage. A chronic persistent conjunctivitis was a rather frequent finding. Often these symptoms were associated with a deficiency in diet or gastrointestinal disease, especially chronic colitis.

In the series reported here, carotene in oil was the source of vitamin A. From the literature, however, it appears that there is little difference whether vitamin A units are taken as cod-liver oil, vitamin-A concentrates, or carotene.

If, as noted above, any disturbance is present which increases the metabolic need for vitamin A or hinders its absorption or storage, larger than normal amounts of vitamin A are necessary. This explains the reason for the necessity of the continued use of carotene in some instances even though the diet was corrected.

It is hoped that this preliminary report may stimulate others to further study the clinical effect of vitamin-A deficiency on the normal functions of the eye.

384 Post Street.

## BIBLIOGRAPHY

- <sup>1</sup>Yudkin. Arch. of Ophth., 1935, v. 14, p. 112.
- <sup>2</sup>Mathews. Vitamins, minerals, and hormones. Baltimore, 1937, p. 3.
- <sup>3</sup>Steenbock. Jour. Biol. Chem., 1919, v. 40, Dec., p. 501.
- <sup>4</sup>von Euler, B., von Euler, H., and Hillstrom. Biochem. Zeit., 1928, v. 203, p. 370.
- <sup>5</sup>Jeghers. Ann. of Int. Med., 1936-37, v. 10, p. 1304.
- <sup>6</sup>Drummond, Bell, and Palmer. Brit. Med. Jour., 1935, v. 1, p. 1208.
- <sup>7</sup>Olcott and McCann. Jour. Biol. Chem., 1931, v. 94, p. 185.
- <sup>8</sup>Mendel. Jour. Amer. Med. Assoc., 1932, v. 98, p. 1981.
- <sup>9</sup>Reports of the Council of the Amer. Med. Assoc., Jour. Amer. Med. Assoc., 1936, v. 106, p. 1732.
- <sup>10</sup>Hess, Lewis, and Barenberg. Jour. Amer. Med. Assoc., 1933, v. 101, p. 657.
- <sup>11</sup>Wilbur and Eusterman. Jour. Amer. Med. Assoc., 1934, v. 102, p. 364.
- <sup>12</sup>Wendt. Med. Klin., 1936, v. 1, p. 27.
- <sup>13</sup>Edmond and Clemmesen. Acta Med. Scandinav., 1936, v. 89, p. 69.
- <sup>14</sup>Altschule. Arch. Path., 1935, v. 20, p. 845.
- <sup>15</sup>Blackfan. Jour. Pediat., 1933, v. 3, p. 679.
- <sup>16</sup>Park. Jour. Oklahoma State Med. Assoc., 1936, v. 29, p. 129.
- <sup>17</sup>Booth and Hansen. Journal-Lancet, 1937, v. 57, p. 530.
- <sup>18</sup>Sandler. Arch. Pediat., 1935, v. 52, p. 391.
- <sup>19</sup>Friderica and Holm. Amer. Jour. Physiol., 1925, v. 73, p. 63.
- <sup>20</sup>Tansley. Jour. Physiol., 1931, v. 71, p. 442.
- <sup>21</sup>Yudkin, Kriss, and Smith. Amer. Jour. Physiol., 1931, v. 97, p. 611.
- <sup>22</sup>Wald. Nature, London, 1933, v. 132, Aug. 26, p. 316.
- <sup>23</sup>———. Nature, London, 1934, v. 134, July 14, p. 65.
- <sup>24</sup>———. Jour. Gen. Physiol., 1934, v. 19, p. 351.
- <sup>25</sup>Jeans and Zentmire. Jour. Amer. Med. Assoc., 1934, v. 102, p. 892.
- <sup>26</sup>Jeans, Blanchard, and Zentmire. Jour. Amer. Med. Assoc., 1937, v. 108, p. 451.
- <sup>27</sup>Jeghers. Jour. Amer. Med. Assoc., 1937, v. 109, p. 756.
- <sup>28</sup>Coward. Biochem. Jour., 1936, v. 30, p. 1878.
- <sup>29</sup>Wilson, Das Gupta, and Ahmad. Indian Jour. Med. Research, 1937, v. 24, p. 807.

## DERMOID (OIL) CYST OF THE ORBIT\*

### REPORT OF A CASE

W. E. BORLEY, M.D.

*San Francisco*

1732 Reports of dermoid cysts of the orbit are to be found infrequently in the literature in recent years, and these tumors are considered by some to be of rare occurrence. Samuels<sup>1</sup> reported on his examinations of dermoid cysts under the microscope, the majority of which showed no unusual features. He considered one of these cases, however, to be an oil cyst of the orbit of dermoid type in which the oil had ruptured through the cystic wall and spread into the subcutaneous tissues back of the fibers of the orbicularis muscle. He believed that dermoid cysts of the orbit were of the rarest occurrence, being more uncommon than intraocular retinoblastoma or sarcoma. He stated that in the literature of the pathological anatomy of the orbit he had been unable to find any description of a spontaneous extrusion of oil from a dermoid cyst of the orbit, although such a condition had been reported by Maresch<sup>2</sup> in dermoid cysts of the ovary and in one of the testis.

Jones<sup>3</sup> reported the case of an oil cyst of the orbit with malignant degeneration and the formation of a squamous-cell carcinoma. He reviewed the literature quite thoroughly and stated that Berlin in 1880 had collected 73 cases of orbital tumors, all but 23 of which were undoubtedly dermoid cysts. Cornwell<sup>4</sup> in 1882 reported the case of an oil cyst of the orbit which began in childhood and in which the eye was finally enucleated

for removal of the entire cyst. Jones further cited a case reported by Hirschberg<sup>5</sup> in 1879 of a dermoid tumor in an adult which had been noted in early childhood. In 1932 Rasquin<sup>6</sup> reported on an oil cyst in a child six years old. The tumor was divided into two parts, one containing a yellowish liquid of oily appearance, the other a sebaceous material. Knapp<sup>7</sup> reported an oil cyst of the orbit in 1923, in a woman 27 years of age, and gave the results of a chemical examination of the content of this cyst. It was found that the oil contained no free fatty acid, but 36.2 percent cholesterol and had an iodine number of 124, indicating that it consisted mostly of triglyceride of a fatty acid. The solid portion of the cyst contained 72 percent of cholesterol. Knapp believed that the proportion of the oil depended on the relative number of sebaceous glands present and that in these oil cysts the oil is a direct product of the sebaceous gland. Harold Gifford<sup>8</sup> in 1923 reported five cases of dermoid tumors and two of oil cysts of the orbit treated with pure liquefied trichloroacetic acid. In 1929<sup>9</sup> he again reported a case of a recurrent dermoid cyst of the orbit operated on unsuccessfully three times, finally completely cured by treating it with pure liquefied trichloroacetic acid. Palomar Collado,<sup>10</sup> cited by Samuels, described a dermoid cyst of the orbit that formed a narrow duct and extended through a tiny channel in the external bony wall, to a knapsack-shaped diverticulum under the temporal muscle. An excellent review of the pathology of these dermoid cysts is given in the report by Samuels.

\*From the Division of Ophthalmology, Department of Surgery, Stanford University School of Medicine, San Francisco, California. Read before the Western Ophthalmological Society at Portland, Oregon, April, 1939.

In the following case there were several unusual diagnostic and pathologic features. These not only show the bizarre fashion in which some of these tumors present themselves, but they may be of some value in the differential diagnosis of orbital neoplasm.

#### REPORT OF CASE

T. M., a male of 27 years, a senior medical student, was first seen on December



Fig. 1 (Borley). Retraction of left lower lid.

1, 1937, when he complained of lacrimation in the left eye that had been present since childhood. He had noted since 1922 that the left palpebral fissure was wider than the right. There were occasional strings of mucus which he could wipe away from his left eye, and sometimes a fairly thick oily secretion. A number of examinations had failed to reveal the cause of the epiphora, although the tear duct had been irrigated numerous times. His mother furnished the information that at one year of age there was a swelling below the left eye which was incised. This swelling recurred several times but apparently subsided with application of hot compresses until at the age of 12 it was again incised.

On examination visual acuity of each eye was 20/20. The patient was wearing a small compound hyperopic astigmatic correction. Muscle balance showed 0.5<sup>A</sup> right hyperphoria for distance, 6<sup>A</sup> exophoria for near. The left eye showed a wider palpebral fissure than did the right,

due to a slight retraction of the lower lid (fig. 1). Exophthalmometer measurements were right 18.5 mm., left 18.5 mm. Extraocular movements appeared to be normal. On everting the left lower lid to expose the cul-de-sac there was found an atrophic conjunctiva in the medial portion of the cul-de-sac with considerable underlying scar tissue. A fistulous tract in the cul-de-sac in the middle of this scar tissue was found, on probing, to extend into the orbit in a posterior and lateral direction, a distance of 2 to 3 cm. (fig. 2). Upon pressure on the lower lid an oily secretion exuded from the opening of the fistula. The tear sac drained freely.

Laboratory examination: A blood count was made, and there were found to be leucocytes 6,000; neutrophils 48 percent, of which 6 percent were banded, 42 percent segmented, 2 percent basophiles, 41 percent lymphocytes, and 9 percent monocytes.



Fig. 2 (Borley). Fistulous opening in cul-de-sac.

The report of the radiology department on November 10, 1937, was as follows: "A small smooth oval object in the floor of the left orbit shows no connection with the bone. It might be a calcified abscess or cyst, or a foreign body" (fig. 3). On December 2d, another X-ray examination was made following lipiodol in-

jection of the fistulous opening in the cul-de-sac, and the report was as follows: "The lipiodol collects in a small cavity which projects to each side and behind the calcified body" (fig. 4). The pre-operative diagnosis was cyst of the orbit, probably dermoid with some calcified material.

On December 15, 1937, an operation was performed for removal of the cyst by Dr. Emile Holman, using local anesthesia. The skin incision was just above the lower orbital rim and extended almost the entire extent from inner canthus to outer canthus. This was carried through



Fig. 4 (Borley). Roentgen appearance after injection with lipiodol.



Fig. 3 (Borley). Roentgenogram of left orbit showing calcification.

the orbital septum and the tumor exposed beneath the eye where it presented itself at the lower orbital rim. It was found to extend laterally almost to the lateral orbital wall and posteriorly toward the apex of the orbit between 3 and 4 cm. The sac of the cyst was found to lie outside of Tenon's capsule, and there was no involvement of the inferior rectus muscle. The inferior oblique muscle was found to lie above the sac wall and was not connected with it. The fistulous opening was injected with methylene blue,

which penetrated into the sac and made identification of the entire tumor quite simple. The collapsed sac was opened anteriorly and the tooth exposed. The fistulous tract was cut away from its opening into the conjunctiva and dissected with the tumor posteriorly, where a few fibrous adhesions at the apex of the orbit were cut loose from the tumor itself. The opening in the cul-de-sac healed satisfactorily without drainage, and there were no postoperative complications (fig. 5).

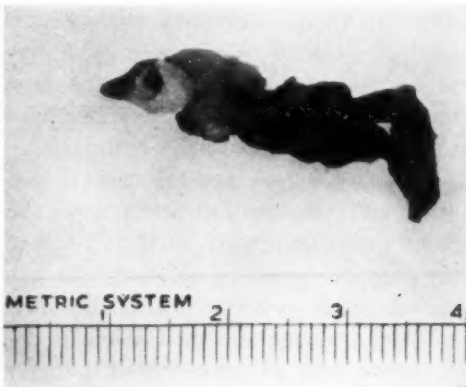


Fig. 5 (Borley). Gross specimen of tumor showing tooth.

Examination on March 25, 1939, showed the fistulous opening to be healed. There was no evidence of recurrence although the retraction of the lower lid was still present to a slight degree. Exophthalmometer readings at that time were right eye 18 mm., left eye 18 mm. There was no complaint of epiphora.

The pathological report is as follows: "The gross specimen consisted of a piece of soft tissue, 2 cm. by 6 mm. in size, with a tooth 7 mm. in length by 3 mm. by 2 mm. at one end. Microscopical examination: Sections show a small tooth with dense fibrous-tissue attachments, adjacent to which are a moderate number of sebaceous glands, sweat glands, and occasional hair follicles. No epithelial lining can be made out. The diagnosis is dermoid cyst of the orbit, benign."

#### DISCUSSION

According to Ida Mann<sup>11</sup> congenital tumors of the orbit, of which dermoids are examples, fall embryologically into three classifications: First there are the tumors composed of only one germ layer; such as the osteomata, angiomata, or nevae. Second, there are the tumors composed of structures from both mesoderm and ectoderm, of which dermoids are good examples, the latter having both mesoblastic and epiblastic elements. In the last group are included those tumors composed of elements of all three germ layers of which there are only the true teratomata. These are exceedingly rare in the orbit and are usually malignant.

This case shows several clinical and pathological changes characteristic of the second group of tumors, no matter where they may be found in the body. Its appearance early in life with probably incision and drainage and then again its development and progress about puberty with possibly again another drainage, and finally the formation of the fistulous tract

are points of interest in the history; whether it actually ruptured spontaneously and formed a fistulous opening in the cul-de-sac or whether this was the result of an incision is not definitely known. The excessive tearing and secretion in recent years in this case was undoubtedly due not only to the secretion of oily material from the cyst itself but to a secondary irritating effect of this oil. From the standpoint of diagnosis this case shows the value of an X-ray examination with demonstration of a calcified body in the orbit and the possibilities of outlining such foreign bodies and cavities with lipiodol.

In general the history of this type of case is fairly characteristic. There is noted early in life a swelling at some point under the lids, usually in the superior temporal quadrant. These swellings may disappear or at least not progress to any extent until puberty when they usually begin to grow and cause irritating symptoms and in some instances fairly marked proptosis. In almost all of the reported cases some therapeutic procedure was found necessary before the age of 30 years. In the case reported by Jones, although the tumor had been noted 10 years previous to operation, the patient was 53 years old at the time of removal. In this case the increased size of the tumor was due to a malignancy developing within its walls and with this case in mind it would seem advisable to remove these tumors or at least to destroy the lining of the wall before the patient reaches what is usually considered the cancer age. Pathologically this case should be classed as a dermoid cyst, for it contains only epiblastic or mesoblastic tissue. This is true also of the cases reported by Samuels. The essential histological characteristics of these tumors consist of an inner lining of epithelium with occasional long or short hairs and

hair follicles, at a somewhat greater depth within the wall sebaceous glands in varying numbers and still deeper occasional sweat glands. Each case, however, may show individual variations and this is well brought out by Samuels. In some of his cases the epithelial lining had disappeared, being replaced by a layer of granulation tissue. He felt this probably depended upon the increased intracystic pressure, which caused the epithelium to become atrophic. In other cases both epithelium and sebaceous glands had disappeared, and the occasional sweat glands had also disappeared due to long-continued intracystic pressure with gradual thinning of the cyst wall. As mentioned previously the few cases showing oil in any large amount were undoubtedly of the type that contained many sebaceous glands.

The treatment of these cysts must be varied depending on their size and location. Gifford stated that practically all the old texts mention excision as the only therapeutic measure. Occasionally, treatment of the cyst wall by tincture of iodine, nitrate of silver, or iodine and 10-percent carbolic acid is mentioned. Gifford believed that his treatment with pure

trichloroacetic acid after curetting the wall afforded a very satisfactory means of cure, and he used it in seven or eight cases with success. He believed that it is of particular value where there are diverticula of the main body of the cyst and where excision may be very difficult. Knapp in his case used a surgical excision employing the Krönlein procedure, and it can be understood why this may become necessary in some cases with large cysts with diverticula extending throughout the orbit. Simple excision would seem to be the method of choice in small well-localized tumors and of necessity is the only method available in cysts including teeth, or in those with fistulous tracts.

#### SUMMARY AND CONCLUSION

1. A case of orbital dermoid or oil cyst is reported.
2. The unusual features of this case are the presence of a fistulous tract opening into the cul-de-sac and the finding of a tooth in the cyst cavity.
3. The diagnostic value of the roentgen examination with lipiodol is pointed out.
4. An enumeration and evaluation of the therapeutic measures employed in these cases is given.

#### REFERENCES

- <sup>1</sup>Samuels, B. Dermoid cysts of the orbit. *Trans. Amer. Ophth. Soc.*, 1936, v. 34, p. 226.
- <sup>2</sup>Maresch. *Festschrift für Prof. Dr. Hans Chiari Wilhelm Braumüller*. Vienna and Leipzig, 1908, p. 36.
- <sup>3</sup>Jones, A. C. Oil cyst of the orbit with carcinomatosis. *Amer. Jour. Ophth.*, 1935, v. 18, p. 532.
- <sup>4</sup>Cornwell, H. G. A compound dermoid cyst of the orbit. *Arch. of Ophth.*, 1882, v. 11, p. 338.
- <sup>5</sup>Hirschberg, J. Oil cyst of the orbit. *Arch. of Ophth.*, 1879, v. 8, p. 373.
- <sup>6</sup>Rasquin, E. *Bull. Soc. belge d'Ophth.*, 1932, v. 64, p. 78.
- <sup>7</sup>Knapp, Arnold. Oil cyst of orbit. *Arch. of Ophth.*, 1923, v. 52, p. 163.
- <sup>8</sup>Gifford, H. The treatment of some forms of dermoid and other cysts with trichloroacetic acid. *Arch. of Ophth.*, 1923, v. 52, p. 448.
- <sup>9</sup>———. Recurrent dermoid cyst. *Arch. of Ophth.*, 1929, v. 2, p. 305.
- <sup>10</sup>Palomar, C. Quiste dermoide orbito-temporal. *Rev. med. de Barcelona*, 1928, v. 9, p. 99.
- <sup>11</sup>Mann, Ida. Developmental abnormalities of the eyes. University Press publication for the *Brit. Jour. Ophth.*, 1937, pp. 411 and 412.

## NEUROMYELITIS OPTICA\*

### REPORT OF A CASE

A. G. ATHENS, M.D.

*Duluth, Minnesota*

This case is reported both because of its comparative rarity, and because of the widespread involvement of the central nervous system with alarming symptoms, from which there has been almost complete recovery.

The patient, a white male, aged 15 years, was referred to me by his family physician on February 22, 1938, complaining that he could not see. About February 8th his vision began to blur while he was in school and within two days it was so poor that he was unable to read at all. He had had frequent frontal and occipital headaches and pains in the eyes on looking up and to the right during this period. He had vomited once four days previously. His appetite was poor.

In early January he had had a mild attack of mumps. Within a week he was normal again. One year before he had had a light attack of scarlet fever. Tonsils and adenoids had been removed when he was five or six years of age.

The patient was an illegitimate child. His home life was not pleasant. His stepfather and mother disagreed as to his discipline and he was considered a "problem child." Nevertheless he progressed well in school and had an intelligence quotient of 87. When away from home at summer camp he seemed quite normal.

On examination, the pupils were found to be equal, 6 mm. in diameter, and reacted to light and convergence. The media were clear. The discs showed a

slight pallor of the temporal halves. The veins were quite full. Vision was reduced to ability to count fingers at two feet in either eye. Fields could not be plotted. The temperature, pulse, and hearing were normal. A Wassermann test made by his family physician was reported as negative. Because his vision began to improve he was not returned again until March 1st, one week after the first visit. During this week he had complained of a soreness in the lower back, his legs had felt weak, and his gait was uncertain. He had some difficulty in starting urination but there was no loss of sphincter control. Vision was thought to be much better.

Examination at this time showed vision in the right eye to be 20/40 — 1 and in the left eye 3/200. The knee jerks were hyperactive, about equal. A suggestive Kernig's sign was present on both sides. In the Rhomberg position there was slight swaying. There was spontaneous past pointing with the left hand but not with the right. A slight tremor of the hands in intentional movements was noted. The patient was a little ataxic, walking a line with difficulty.

He complained of pain on rotating the eyes up and out. Rotations were not limited. There was no nystagmus. The pupil of the left eye was a little larger than that of the right, both reacting to light and convergence. There was one small superficial retinal hemorrhage in the right eye and the pallor of the discs had not changed. Visual fields were normal in outline but showed enlarged blind spots and a large central scotoma in the right and a cecocentral scotoma in the

\* Read before the Minnesota Academy of Ophthalmology and Otolaryngology, April 28, 1939.

left. Except for a faint recognition of blue, color sense was lost in the left eye. In the right eye the field for blue was about normal, that for red limited to within two or three degrees of the fixation point. Green was gone entirely.

Examination of the blood revealed 75 percent hemoglobin, 4,320,000 red blood cells, and 20,000 leucocytes, 89 percent of which were neutrophiles.

The patient rapidly became more ataxic, headaches, nausea and vomiting increased, and a definite scanning of speech developed. He was admitted to the hospital on March 4th. The interne's report on admission recorded a horizontal nystagmus. I did not observe this even during a period of extreme vertigo. For two periods of about 12 hours each vertigo was severe, the patient being unable to lift his head or even to turn to the right side. As long as he lay quietly on the left side he was comparatively free from dizziness.

The pulse was irregular and an electrocardiogram revealed a high-grade sinus arrhythmia. The interpreter of the tracing diagnosed myocardial disease. This subsequently proved to be an error as the arrhythmia disappeared. There was urinary retention and tenderness over the lumbar spine. The abdominal and all the tendon reflexes were more active on the left. The neck muscles were somewhat rigid. Temperature remained normal. He was unable to retain anything by mouth. After an enema, which he was unable to expel, he had, while asleep, two involuntary stools.

The spinal fluid showed a pressure of 19 mm. Hg; 180 cells, 90 percent of which were lymphocytes, 10 percent neutrophiles; chlorides, 756.0 mg.; sugar, 41.5; protein, 138.5; a trace of globulin. The Kline test was two plus but a specimen sent to the state laboratory was reported negative for both Kline and Kol-

mer. The colloidal gold curve was considered to be normal. X-ray studies of the ends of the long bones were negative for lead and no lead was found in the urine.

It was obvious that we were dealing with a widespread demyelinating disease of the central nervous system. The sudden onset in a boy of 15 with marked visual loss in both eyes, the very rapid development of alarming symptoms, and rapid recovery of vision appeared to distinguish it from multiple sclerosis to which disease it most nearly corresponded. A diagnosis was made of neuro-myelitis optica.

The patient left the hospital on March 11th, one week after admission, apparently much improved. However, on March 16th his speech became impaired. He had difficulty in making himself understood, although he remained mentally clear. Diplopia developed but was transient. The incoördination of the arms and legs was persistent for several weeks. He was unable to tell the position of the extremities in bed. He had to be carried up and down stairs. At one time he had a crying spell which lasted for two or three hours. Different parts of the brain and cord appeared to be attacked by the disease without any progressive relationship as the symptoms shifted erratically. One by one they gradually disappeared until recovery was considered complete about 10 weeks after the onset.

A final examination was made on June 23d. When his mother was asked to send him in for this he was caddying on a golf course. He stated that he had no difficulty in seeing, walking, or talking and he appeared to be in normal health. A neurological examination showed slight spontaneous past pointing to the left. There was a little incoördination when he attempted to touch fingers together and in the heel-to-shin test. The Babinski reflex was suggestive. The abdominal and

tendon reflexes were normal. He walked normally, and there was no slurring of his speech. When the eyes were rotated sharply to the right there was a slight nystagmoid movement, none when rotated to the left. The temporal halves of the discs were quite pale, and the margins sharply outlined. Visual fields were normal for form and colors. The physiological blind spots were not enlarged. Vision was 20/25-1 in the right eye and 20/30-1 in the left. He read Jaeger 1 type with a little difficulty. There was no improvement with lenses.

The first recorded case of this disease was described by Sir Clifford Allbutt<sup>1</sup> in 1870. Among other interesting cases of spinal disease and injury Allbutt reported one of acute myelitis with what he called "sympathetic disorder" of the eyes. The latter came on 12 weeks after the subsidence of the spinal symptoms. The "sympathetic disorder" referred to was optic neuritis. There was partial recovery. A considerable number of cases were reported during the next few years. In 1894 Devic<sup>2</sup> reviewed the previously reported cases, added a case of his own, and named the disease. It was subsequently referred to as "Devic's syndrome." Probably the clearest early clinical description of the disease was given by Chisholm,<sup>3</sup> an ophthalmologist of Baltimore, in 1882. The symptoms in his case began with pain on movement of the eyes. Within three days blindness was complete. The patient died on the twelfth day from progressive ascending paralysis from the feet upward.

In 1927 Beck<sup>4</sup> reviewed the literature and found 70 recorded cases of paraplegia associated with blindness. He reported a case of his own. Of these 70 cases only 18 were recorded in the ophthalmic literature. In 18 of these, blindness came on first, in 36 myelitis was first to appear, and in 10 the two appeared simultaneously. In four the neuritis was

discovered only on routine ophthalmoscopic examination. In Beck's case, a girl of 15 years, the onset was sudden with headache, vomiting, drowsiness, and malaise. Six weeks later vision was suddenly lost.

In 1935 the literature was again reviewed by Walsh,<sup>5</sup> who reported four cases of his own, one of which was studied pathologically. Altogether, a few more than 100 cases are recorded. About one third of these have come to autopsy and have had histopathological studies. The latest cases recorded are two by McKee and McNaughton<sup>6</sup> in 1938. A large percentage of the cases have occurred in children in their 'teens or earlier. Balser,<sup>7</sup> who reported four cases and studied three pathologically, believes that many of the cases recorded in the literature are undoubtedly instances of acute disseminated sclerosis. Because of its widespread involvement of the myelin sheaths, some neurologists consider the disease to be an acute form of disseminated sclerosis. Others, particularly those who have made histopathological studies, are emphatic in differentiating it as a separate disease. Hassin,<sup>8</sup> after an exhaustive histological study of a case, concluded that it is a definite disease entity both clinically and pathologically. Other diseases which may produce lesions of both spinal cord and optic nerve are acute diffuse encephalomyelitis, widespread tumor of the central nervous system, cerebrospinal lues, and Schilder's disease. Tumor and lues offer little difficulty in diagnosis. Encephalomyelitis usually shows more mental symptoms and is generally self limited. Schilder's disease occurs earlier in life and blindness generally is of the cerebral type. The cord is rarely involved. Temporal atrophy of the disc is uncommon. Acute multiple sclerosis usually occurs in adults, and bilateral severe blindness is rare. Pathologically, according to Walsh, the

cerebellum in neuromyelitis optica is not involved, and the same author states that gliosis is absent in the latter disease. Brain<sup>9</sup> has stated that "coincident bilateral optic neuritis with myelitis is unknown in multiple sclerosis" and also that multiple sclerosis rarely occurs in childhood. Beck detailed pathological findings which he considered further differentiated the disease from multiple sclerosis. Among these were (1) rarefaction and cavitation of the cord, optic nerve, and chiasma; (2) leucocytic exudates in these structures; (3) extensive demyelination through numerous segments of the cord; and (4) perivascular round-cell infiltration throughout the central nervous system.

In neuromyelitis optica rapid and marked loss of vision is probably the most characteristic symptom. According to Goulden<sup>10</sup> it was the first symptom in 80 percent of the recorded cases. In the recovered cases, vision tends to improve nearly as rapidly as it is lost. This visual loss in most cases appears to be due to an optic neuritis, although some of the cases have shown lesions in the optic radiations. Papilledema has been reported a number of times. Klar<sup>11</sup> thought the edema that was found in his case to be due to a lesion immediately behind the eye. Walsh states that there is rarely an increase in the intracranial pressure. Venous engorgement, which occurred in my case, is frequently mentioned, usually, however, accompanied with some edema of the disc. Pallor of the temporal side of the discs is seen in most cases and is no different from that found in multiple sclerosis, unless it be more marked. Dilatation of the pupils may be due to visual loss or to irritation to the sympathetic nuclei in the medulla or cord. Orbital pain on movement of the eyes is a common complaint of the patients and was present in my case. The extraocular muscles are rarely

involved. In my case a transient diplopia developed. A great variety of fields have been described. Central scotomata are the most frequent type of field reported. Red and green disappear before the blue. Hemianopsia is not uncommon. Beck's case showed a bitemporal hemianopsia. Holden's<sup>12</sup> first four cases all showed such fields. One of Walsh's patients had hemianopsia and was operated on for pituitary tumor.

The myelitic symptoms generally consist of numbness and weakness, appearing first in the legs; ataxia; loss of sense of position of the extremities; retention or incontinence of urine and feces; weakness or loss of superficial reflexes and exaggeration of deep tendon reflexes.

Cardiac arrhythmia, such as occurred in my case, appears to be rare. One of Holden's patients had an arrhythmia without a demonstrable lesion. Death, when it ensues, is usually due to respiratory failure.

The etiology of the disease is obscure. A neurotropic virus has been suggested, and attempts have been made to isolate such a virus with no success. Lead was found in one case of neuromyelitis optica and in seven cases of multiple sclerosis in the urine, stools, spinal fluid, or blood cells or in all of these by Cone, Russel, and Harwood<sup>13</sup> and considered to be a possible etiological agent. It is known, however, that lead is practically a normal finding in the stools and urine of healthy individuals. Lues, though found in two of the reported cases, is generally thought not to be an etiological factor.

No treatment is considered to be of any particular value. Most suggestions are empirical. High-vitamin diet and quinine have been suggested and were used in this case. Arsenic is said to be contraindicated. Walsh cautions against lumbar puncture and believes that any extensive surgical procedure is likely to exaggerate the

symptoms and may prove fatal. According to Goulden recovery has occurred in about 50 percent of the reported cases. If the cases of doubtful diagnosis are eliminated the percentage of recoveries is probably considerably higher.

#### SUMMARY

A case of acute diffuse myelitis with sudden blindness in a 15-year-old boy is reported. The fields showed large central scotomata and loss of color sense for red and green. There was deep orbital pain, particularly on rotating the eyes. Three weeks after the onset of blindness there was rapid development of myelitic symptoms beginning with weakness of the legs, uncertain gait, and soreness in the lower back. Retention of urine began early, and later there was constipation and incontinence of stools. The cord symptoms

spread upward. The patient developed extreme vertigo and loss of sense of position of the extremities. A high-grade cardiac arrhythmia developed and was misinterpreted as indicating myocarditis. The tendon reflexes were hyperactive. There were 180 cells in the spinal fluid and an increase in the blood leucocytes. Recovery was rapid and nearly complete.

While showing many of the symptoms of multiple sclerosis, the high degree of bilateral visual loss, the age of the patient, and no sign of relapse after several months would seem to distinguish it as a separate disease. The cases that have come to autopsy have furnished considerable pathological evidence that would tend to further differentiate this disease from multiple sclerosis.

1214 Medical Arts Building.

#### BIBLIOGRAPHY

- <sup>1</sup> Allbutt, C. On the ophthalmoscopic signs of spinal disease. *Lancet*, 1870, v. 1, p. 76.
- <sup>2</sup> Devic, C. De la neuromyelites optique aiguë diffuse avec double névrite optique. *Arch de Med. Exper.*, 1894, v. 1, p. 696.
- <sup>3</sup> Chisholm, J. J. An obscure case in nerve pathology accompanying optic neuritis. *Arch. of Ophth.*, 1882, v. 40, p. 239.
- <sup>4</sup> Beck, G. M. A case of diffuse myelitis associated with optic neuritis. *Brain*, 1927, v. 50, p. 687.
- <sup>5</sup> Walsh, F. B. Neuromyelitis optica. An anatomical-pathological study of one case. Clinical studies of three additional cases. *Bull. Johns Hopkins Hosp.*, 1935, v. 56, April, p. 183.
- <sup>6</sup> McKee, S. H., and McNaughton, F. L. Neuromyelitis optica. *Amer. Jour. Ophth.*, 1938, v. 21, Feb., p. 130.
- <sup>7</sup> Balser, B. H. Neuromyelitis optica. *Brain*, 1936, v. 59, p. 353.
- <sup>8</sup> Hassin, G. B. Neuroptic myelitis versus multiple sclerosis. *Arch. Neur. and Psychiat.*, 1937, v. 37, May, p. 1083.
- <sup>9</sup> Brain, A. R. Diseases of the nervous system. Oxford University Press, 1937, p. 397.
- <sup>10</sup> Goulden, C. Optic neuritis and myelitis. *Trans. Ophth. Soc. U. Kingdom*, 1914, v. 34, p. 229.
- <sup>11</sup> Klar, J. Encephalomyelitis optica acuta. *Klin. M. f. Augenh.*, 1932, v. 89, p. 645-655.
- <sup>12</sup> Holden, Ward. A report of four cases of acute disseminated myelitis with retrobulbar degeneration of the optic nerves. *Arch. of Ophth.*, 1911, v. 40, p. 569.
- . A fifth case of acute disseminated myelitis with retrobulbar inflammation of the optic nerve. *Arch. of Ophth.*, 1914, v. 43, p. 231.
- <sup>13</sup> Cone, William; Russel, Colin; and Harwood, R. U. *Arch. Neur. and Psychiat.*, 1934, v. 31, Jan.-June.

## TETANUS AND THE PROPHYLACTIC USE OF ANTITOXIN FOLLOWING INJURIES OF THE EYE\*

DAVID G. COGAN, M.D.

*Boston*

It has been the practice of some eye hospitals, including that of the Massachusetts Eye and Ear Infirmary, to give tetanus antitoxin prophylactically in every case of perforating injury of the eye. This routine has been most recently recommended by Burger.<sup>1</sup> But the free use of antitoxin is not without undesirable features, and it is the purpose of this study\*\* to determine whether or not the liability to tetanus following ocular injuries is sufficiently great and the prophylaxis by the antitoxin sufficiently certain to warrant its use in every case.

Tetanus is such a spectacular complication of ocular injury that one may assume that most, if not all, instances of it have been reported. The literature probably gives, therefore, a true indication of its frequency. Wagenmann<sup>2</sup> in 1907 was able to find in the literature only 14 case reports of the condition. By 1916 the number had been augmented, largely by war injuries, and Schneider<sup>3</sup> was able to collect reports on 20 cases. In 1921 Collin<sup>4</sup> collected 23 case reports including one of his own. One other case (Sattler's,<sup>5</sup> 1918), which he had apparently overlooked, had been reported, bringing the total to 24. In the literature since 1921 to the present I have been able to find only 3 case reports of undoubted tetanus following perforating injuries (Jacqueau and Bujadoux,<sup>6</sup> Burger,<sup>1</sup> Stark<sup>7</sup>), 1 probable but unproved case (Addario la Ferla's<sup>8</sup> 2d case), and 1 following a traumatic keratitis without perforation (Ad-

dario la Ferla, 1st case). If the last two are included, the total number of case reports of tetanus following injury to the eye is now not more than 29. Approximately one half of these cases occurred before there was general use of antitoxin prophylactically,<sup>†</sup> and in none of these cases was antitoxin given before the onset of tetanic symptoms.

Apparently the agent inflicting the injury is of the utmost significance. One is impressed by the frequency with which horsewhips have been responsible. Of the 25 reports in which the nature of the inflicting agent is stated, no less than 10 were instances of horsewhip injuries. Two others were caused by objects which had previously had intimate contact with horses: 1 by a fragment of a horseshoe and the other by a pitchfork. Thus 12 injuries were known to be caused by agents associated with horses. Of the remaining cases in which the nature of the responsible agent is stated, 7 injuries were caused by objects associated with the ground (1 by a clump of earth, 2 by plant stalks, 1 by a broom, 1 by an arrow which had previously been stuck in the ground, and 2 by firecrackers). Thus agents which have been contaminated by direct contact with horses or with the ground account for the majority of cases of tetanus following ocular injury. Only 6 of the 25 reports did not give such a history. Of these 1 was caused by a "dirty piece of porcelain," 1 by cataract couching, 1 (the unproved case) by a splinter of wood, and only 3 (exclusive of the horseshoe injury mentioned above) by metallic foreign bodies.

\*From the Howe Laboratory of Ophthalmology, Harvard University, and the Massachusetts Eye and Ear Infirmary.

\*\*Suggested by Dr. F. H. Verhoeff.

† Prophylactic tetanus antitoxin was not in widespread use until the World War.

This is all the more striking in view of the frequency of the latter type of injury. One of these metallic injuries was caused by a piece of tool employed on wood, and it is possible that if a more complete history were available we might find a history of contamination with the ground in all three.

Tetanus following injury of the eye is usually accompanied by panophthalmitis or other form of severe endophthalmitis. There is a positive history of panophthalmitis in 16 instances, of hypopyon in 3, of corneal ulcer in 1, and of severe conjunctivitis in 1. In the remaining case reports the data given are insufficient to determine what ocular complications developed. But in no instance is there any indication that the eye did not show marked inflammation. This is interesting in view of the fact that suppuration is not necessarily a feature of tetanus infections elsewhere in the body. It is probable that the suppurative process in the eye is caused by organisms other than the tetanus bacillus. At least experimental inoculation of the eye in rabbits would suggest this (Ulrich<sup>9</sup>). When pure cultures of *B. tetani* are injected into the eye, only mild iridocyclitis will develop, and the organisms may actually be harbored for weeks with only a mild reaction. If, however, other organisms such as *B. subtilis* are simultaneously injected with the tetanus bacilli, panophthalmitis will develop as in the clinical cases under consideration. Tetanus is more apt to result from mixed inoculations than from injections of pure cultures of tetanus bacilli and this may well explain why panophthalmitis is such a common feature in the clinical reports.

In this connection it is also interesting that attempts to recover the organisms have been noted in at least five of the case reports in the above clinical series. *B. tetani* have been recovered twice: once

from the eye and once from the foreign body (two months after the injury and some weeks after the death of the patient!). In three instances no tetanus bacilli could be recovered. Tetanus bacilli were recovered from the ocular wound in one other case (Wirtz<sup>10</sup>) which is not included in the above series because tetanus never developed. This was again a horse-whip injury with perforation of the globe. As soon as the organisms were discovered, serum was given and clinical tetanus never occurred.

It would seem logical that removal of the eye might lessen the chances for generalized tetanus. But by the time panophthalmitis has appeared and enucleation is indicated, the tetanus infection may have extended beyond the eye. Thus of 8 patients who had an enucleation, only 1 recovered. One of the patients who died had actually had an enucleation on the day of the injury, before panophthalmitis developed. Of the 3 patients who had had an evisceration of the eye, on the other hand, 2 recovered and the outcome in the third is not stated. From this it might seem that evisceration was preferable to enucleation. Of the instances in which no operation was performed, probably the majority, recovery occurred in 2 with ultimate phthisis bulbi.

The general symptoms of tetanus following ocular injury usually begin from the sixth to eighth day and show at first the cephalic type of tetanus with lockjaw, facial paralysis, and ophthalmoplegia. This is followed by generalized convulsions. It is a severe type of tetanus, death having been noted to occur in 22 of the 27 case reports in which the end result is stated.

As previously stated, prophylactic antitoxin was apparently not used in any of the patients in this series, and there is no report of tetanus having occurred from ocular injuries where it was used. Further-

more, the relative infrequency of tetanus from ocular injuries during the war can doubtless be accredited to the liberal use of antitoxin, for many of the wounds must have been contaminated by ground containing tetanus spores. But it is well known that injuries elsewhere in the body have resulted in tetanus despite the prompt administration of prophylactic antitoxin. There is no reason to believe it could not likewise develop as a result of ocular injuries. It is possible that in the more severe infections the amount of antitoxin given prophylactically is insufficient. There is no contraindication to repeating the usual prophylactic dose of 1,500 units during the week following the first injection.

From this brief analysis certain conclusions may be drawn:

The development of tetanus following ocular injury is usually, if not always, associated with panophthalmitis. This panophthalmitis, however, is caused by organisms other than *B. tetani*. Enucleation does not offer any assurance against the development of generalized tetanus even when performed during the first 24 hours after the injury, and apparently does not affect the mortality rate.

Tetanus following ocular injury is obviously a rare catastrophe, for it has been reported in the literature only 20 times. That this relative infrequency is not simply the result of prophylactic antitoxin is apparent from the fact that there were only 14 case reports of the condition in the entire world literature before the days of prophylactic antitoxin. In view of this relative infrequency and of the danger incident to the administration of serum, it might seem that prophylactic use of antitoxin is never indicated following ocular injury. But practically all those injuries that did result in tetanus had been caused by objects associated with horses directly or with ground probably contaminated by manure. It would seem justifiable, therefore, to give antitoxin in those cases in which there is a history of such contamination. These would actually comprise a very small percentage of the total number of cases of injury to the eye. While a single prophylactic injection of 1,500 units is probably adequate, repetition of this once during the first week would be justified as an added precaution.

243 Charles Street.

#### REFERENCES

- <sup>1</sup> Burger, A. H. Diss. Wurzburg, 1927.
- <sup>2</sup> Wagenmann, A. Graefe-Saemisch Handbuch, 1910, v. 9, pt. 5, chap. 17, I, p. 132.
- <sup>3</sup> Schneider, E. R. Ann. d'Ocul., 1916, v. 153, p. 395.
- <sup>4</sup> Collin, M. A propos d'un cas de tétanos consécutif à une plaie oculaire. Paris, 1921.
- <sup>5</sup> Sattler, R. Arch. of Ophth., 1918, v. 47, p. 64.
- <sup>6</sup> Jacqueau and Bujadoux. Lyon méd., 1925, v. 136, p. 442.
- <sup>7</sup> Stark, A. Zentralbl. f. d. ges. Ophth., 1929, v. 22, p. 854.
- <sup>8</sup> Addario la Ferla, G. Ibid., 1931, v. 25, p. 314.
- <sup>9</sup> Ulrich, H. 32 Vers. Deutsch. Ophth. Gesellsch., Heidelberg, 1905, p. 256.
- <sup>10</sup> Wirtz. Klin. M. f. Augenh., 1908, v. 46, p. 606.

# INTRAOCULAR FOREIGN BODIES

SOME COMMENTS BASED ON 120 CASES\*

ELBERT S. SHERMAN, M.D.

Newark, New Jersey

The cases here recorded, which are consecutive and unselected, have all passed through my office during the past few years. There were a number of earlier ones, the records of which were either incomplete or not located. Not included are cases in which the foreign body had perforated the coats of the eyeball but was still in the wound and was removed by forceps or other means, and cases sent for examination by insurance companies, the Compensation Bureau, or other physicians. The conclusions are based largely on the failures and successes experienced in dealing with this series of cases.

One hundred and twelve (93 percent) of the foreign bodies were or presumably were magnetic steel. The others were copper, brass, rock, tungsten wire, carbon, bird shot, and nonmagnetic steel. There may have been other instances of nonmagnetic steel, but I have been reluctant to give this as a reason for failure to recover an intraocular foreign body.

The causes of the various accidents were:

Hammering or striking metal		
with a tool .....	73	(61 percent)
Flying particles .....	25	(21 percent)
Various causes .....	12	(10 percent)
Not recorded .....	10	( 8 percent)

Location of the wound of entrance in this series:

Cornea .....	69	(57.5 percent)
Limbus .....	10	( 8.3 percent)
Sclera .....	27	
Sclera and ciliary body 14}	41	(34.2 percent)

\* Read before the Ophthalmological Section, New York Academy of Medicine, May 15, 1939.

In 223 cases reported by Allport:<sup>1</sup>

Cornea .....	112	(50.2 percent)
Limbus .....	21	( 9.4 percent)
Sclera .....	90	(40.3 percent)

In several of the cases the upper or lower lid was also perforated.

Most of the foreign bodies were 2 to 4 millimeters in the greatest dimension. Larger missiles cause such great and immediate damage by their lacerating, contusing, or concussion effects that the restoration of good vision is infrequent; moreover, they are more likely to carry infection into the eye.

The largest foreign body in this series was a sliver of steel that had passed completely through the eye. The anterior end was in the orbit in contact with the globe, and the posterior end was in the sphenoid sinus on the opposite side. It was withdrawn with forceps after the eye had been enucleated.

The largest piece of steel that I have removed from the vitreous without great loss of vision was a rough chip 8 mm. by 3.5 mm. in size. It entered through the upper margin of the cornea of the right eye, tearing away a large piece of the anterior layer of the iris. The lens was not injured. The roentgenologist located the foreign body in the upper part of the vitreous, the posterior end being 13 mm. behind the cornea. It was removed the day after the accident, through the wound of entrance, with a Lancaster hand magnet. Adherent to it was the missing piece of iris. Two months later the vision was 20/50 with a quiet eye. After the lapse of two years the

man returned for treatment of an injury of the cornea of the left eye. The condition of the right eye was unchanged. Nearly five years after the injury of the right eye he was again sent to me for another injury of the same eye. There was a wound of the upper lid and a laceration of the bulbar conjunctiva. The vision was then 20/40.

In 54 (45 percent) cases the lens was injured; uninjured in 64 (53.3 percent);

There were no cases of sympathetic ophthalmia, although enucleation was refused after being advised for several severe injuries of the ciliary body. There were 14 enucleations and in 8 cases enucleation was advised but not permitted.

In only two cases did detachment of the retina occur—one after removal of the foreign body through an incision in the sclera and the other when removal was by the anterior route. Recovery oc-

TABLE 1  
LOCATION OF FOREIGN BODY WITH RESULTANT VISION

Location of Foreign Body	No. of Cases	Blind Eyes and Enucleations	Vision						
			Less than 20/200	20/200 to 20/100	20/100 to 20/70	20/70 to 20/50	20/40	20/30	20/20 or better
Vitreous, retina, and postscleral wall	82	22	20	1	3	5	2	12	17
Lens (removed not removed)	5			3				1	1
	5	1	1	1		1	1		
Ant. chamber and iris	17							4	13
Posterior chamber	3					2		1	
Orbit (double perforation)	8	1	3	1	1	1		1	
Total	120	24	24	6	4	9	3	19	31

lens injury was undetermined in two. However, in 20 of the cases in which the lens was uninjured the foreign body did not penetrate farther than the posterior chamber.

Siderosis bulbi was observed in seven eyes. The shortest period of its development was, as nearly as could be determined, about five months. However, according to Davidson,<sup>2,3</sup> Mayou,<sup>4</sup> and others, siderosis may appear much earlier than this. No instance of the disappearance of siderosis was noted. Vogt<sup>5</sup> reported one case.

Several times after negative reports by roentgenologists the presence of an intraocular foreign body was demonstrated.

curred in both without operation. The vision in each case was 20/30. Most of these injured eyes were seen soon after the accident occurred—many of them within two or three hours or less, and the foreign body was removed as promptly as possible. In 74 cases removal was effected during the first 48 hours after the accident, in 46 of these within 24 hours. However, in a number of instances the foreign body had been retained for many months.

Table 1 shows the location of the foreign body in 120 cases and the visual acuity at the time of the latest observation.

Table 2 shows the route by which the

foreign bodies located in the vitreous or retina were removed, and the visual results.

It is apparent that 16.6 percent of the foreign bodies were in the anterior segment of the eye, 8.3 percent were in the lens, 68.3 percent were in the posterior segment, and 6.6 percent were in the orbit. Of the 82 cases of posterior-segment foreign body, the patients in 47.5 percent recovered with vision of 20/70 or better. Twenty-nine (35 percent) of these had 20/30 or better.

face. The posterior end had perforated or was embedded in the iris. It was removed with forceps through a peripheral incision in the cornea. The eye recovered promptly with normal vision.

The eight cases of double perforation were interesting in that in only one was there much inflammatory reaction. Four that recovered with less than 20/200 vision had cataracts caused by perforation of the lens by the missile. All would probably have had better vision if the cataracts had been removed, as there was

TABLE 2  
FOREIGN BODY IN VITREOUS AND RETINA, REMOVAL ROUTE, AND VISION

	No. of Cases	Blind Eyes and Enucleations	Vision						
			Less than 20/200	20/200 to 20/100	20/100 to 20/70	20/70 to 20/50	20/40	20/30	20/20 or better
Removed by anterior route	44	12	11		2	4	2	8	5
Removed through sclera	27	7	6		1	1		3	9
Not removed	11	3	3	1				1	3
Total	82	22	20	1	3	5	2	12	17

The visual results for the whole series were 20/70 or better in 51.6 percent and 20/30 or better in 41.6 percent.

As would be expected, the results in the patients in whom the foreign body was in the anterior chamber or iris were much better. Of these there were 17. All of them recovered with at least 20/30 vision—4 had 20/30 and 13 had 20/20. In all but one instance the foreign bodies were particles of steel. The exception was a very fine piece of tungsten wire from an incandescent-lamp filament. A factory worker was testing lamps when one exploded and something struck her eye. It was found that a piece of the filament had perforated the cornea and was broken off flush with the anterior sur-

no indication of retinal detachment or other serious intraocular disturbance.

Two of the double-perforation cases are worth describing briefly:

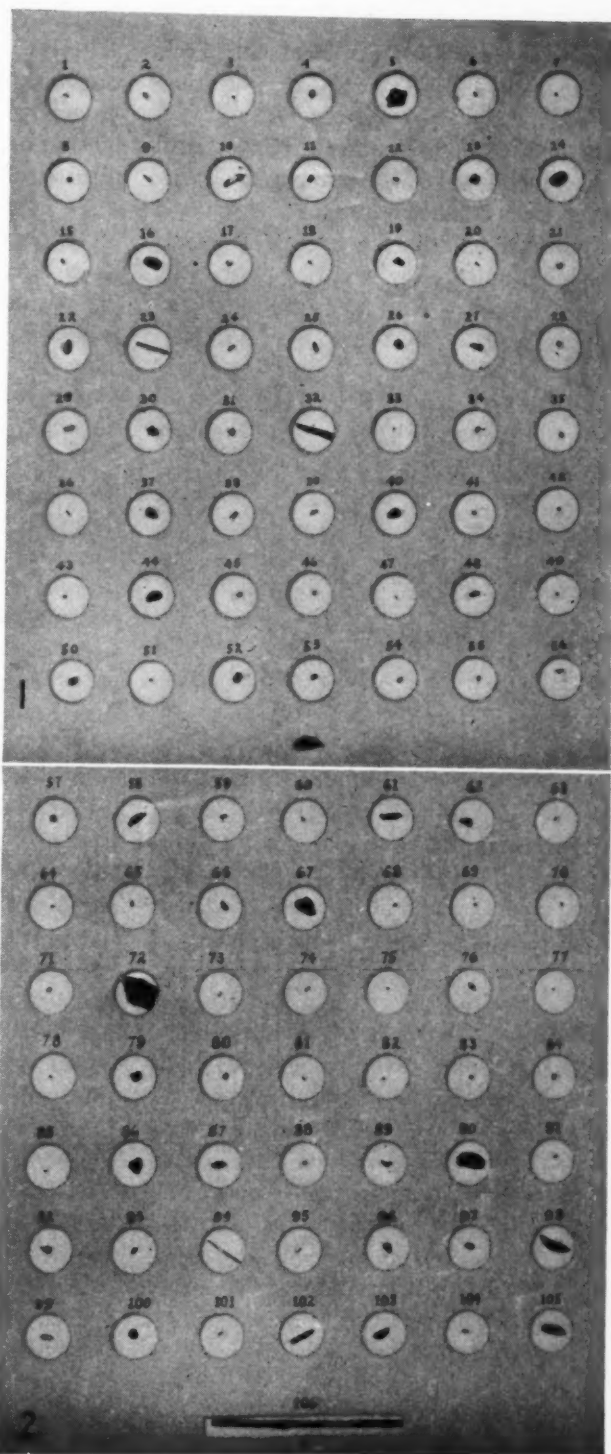
*Case 1.* While duck hunting, a young man was struck in the right eye by bird shot. When he came to me three days later there was a closed, perforating wound in the right lower lid and another in the sclera 3 mm. below the cornea. In the retina, well below the disc on the nasal side, there was a fairly large hemorrhagic area. The roentgen examination showed a round foreign body, 4 mm. in diameter, a short distance behind the eyeball. The eye was fairly quiet and remained so. The vision was ability to see hand movements. Over two years later

the media were clear. There was a fairly large pigmented scar in the fundus at the site of the wound of exit. The vision was 20/50.

**Case 2.** A man, aged 33 years, while striking a chisel with a hammer, was struck in the right eye by a chip of steel. He came to me one hour after the accident. There was a small wound in the sclera 2 mm. below and to the nasal side of the cornea. A wound could be seen in the retina well below and to the temporal side of the disc. Except for two air bubbles and a little blood the vitreous was clear. The vision was 20/30. The roentgen examination revealed a foreign body 3 mm. by 1 mm. in the orbit, just outside the eyeball. There was no response to the giant magnet. The next day a hemorrhage into the vitreous reduced the vision to 20/200. This cleared up rapidly, and three weeks later the vision was 20/20, and the man had returned to work. Two years later the vision was 20/20.

The only case of uncomplicated, retained intraocular foreign body observed over a long period occurred in a young man whose left eye was perforated through the sclera by a piece of steel.

**Figs. 1 and 2 (Sherman).** Various sizes and shapes of over 100 intraocular particles of steel. Diameter of circles is 12.5 mm. No. 106 is the piece, 57 mm. long, shown in the roentgenogram.



The foreign body could be seen deep in the vitreous. The X-ray localization was 17 mm. behind the cornea near the median line, and the estimated size was  $4\frac{1}{2}$  mm. by  $7\frac{1}{2}$  mm. The tool from which it was thought to have come was magnetic steel. All attempts to move it with a magnet were futile. There was very little reaction and the eye recovered promptly but with vision reduced to light perception. Eleven years later the eye had remained quiet, the vision was 5/200 and the location of the foreign body was apparently unchanged.

Of the 82 foreign bodies in the vitreous and retina, 44 were removed by the anterior route, and 27 through the sclera; 11 were not removed. Most of the latter were nonmagnetic. Twenty-three (52.3 percent of the 44 eyes from which the removal was by the anterior route were industrially blind (less than 20/200), and 21 (47.7 percent) had 20/100 to 20/15 vision; 13 (29.5 percent) of these recovered with vision of 20/30 to 20/15.

Thirteen (48 percent) of the 27 eyes from which the removal was through the sclera were industrially blind and 14 (52 percent) had 20/100 to 20/15 vision; 12 (44.4 percent) of these recovered with vision of 20/30 to 20/15. These figures are not offered as proof of anything. The number is too small to allow any conclusions to be drawn, from the visual results, as to the comparative value of the two routes. However, a review of the records shows that the foreign bodies removed through the sclera were larger, and the primary injuries often more serious—the ciliary body, in several instances, being severely injured. On the other hand, the anterior route was often chosen when the lens was badly damaged.

Some writers have criticized reports of good visual results following the removal of foreign bodies from the vitre-

ous, by calling attention to the fact that in most instances the period of observation has been too short; that late degenerative changes and detachments of the retina often completely change the picture. Twelve eyes in my series of cases in which there was recovery with good vision (20/30 to 20/15), and in which foreign bodies were removed from the vitreous through the sclera, were followed up for periods varying from six months to 15 years, the average period of observation being four years. In none was there any deterioration of vision, and in several there was considerable improvement. In only one was there detachment of the retina. This occurred four weeks after the removal of a chip of steel, 2 mm. by  $2\frac{1}{2}$  mm. in size, which had entered through the sclera and ciliary body. There was considerable hemorrhage into the vitreous. Vision was reduced to the ability to count fingers at 2 feet. The foreign body, after X-ray localization, was removed through a scleral incision with a hand magnet. Four weeks later the vision, which had been 20/40, was suddenly reduced to 20/200 as a result of a small detachment of the retina near the site of the extraction. This became reattached during three weeks confinement to bed, and remained in place. Nine months later the vision was 20/30. Five years later, when the man returned because of a minor injury of the same eye, it was still 20/30.

It was impossible to keep some eyes that recovered with good vision under prolonged observation, but as nearly all of these were workmen's compensation cases in which the claim could be reopened within two years, it is more than likely that I would have heard from any that had deterioration of vision within that time. In many of the patients who sustained great permanent loss of vision from cataract, organized exudates in the

vitreous, and other causes, there was, of course, no way of determining whether subsequent changes, such as detachment of the retina, occurred.

If it is safe to draw any conclusions from such a small number of cases, it would seem that detachment of the retina following removal of a foreign body through an incision in the sclera is not necessarily a frequent sequel, and that the statement of a writer<sup>6</sup> on this subject that "It is significant that the longer the period of time elapsing, the greater seems to be the diminution of vision" is rather pessimistic.

Probable factors in my comparatively favorable late results are early removal of the foreign body in most cases, and my refraining from entering the vitreous with magnet tips or instruments. Only recently have I used electrocoagulation or other similar means for preventing retinal detachment.

The entrance of a foreign body into the eye is always a serious matter, the ultimate result of which no one can foretell. No two cases are alike, and in each the selection of the proper procedure should be influenced by the conditions present. Adequate equipment (a point stressed by Lancaster<sup>7</sup>), experience, and good judgment are often the deciding factors between success and failure. Bane<sup>8</sup> says that "training in the use of the magnet is as important as that for the removal of a cataractous lens."

In the event of a recent invasion of the eye by a foreign body, particularly when it is iron or steel, temporizing is definitely bad practice. It should be removed as soon as a thorough examination can be made, including an X-ray localization when needed. To me this seems so important that in some cases of an open wound, when a roentgen report could not be had promptly, I proceeded without it rather than delay re-

moval for even a few hours. After the eye has become red and painful, the operation is more difficult and dangerous. Furthermore, the foreign body may in a short time become bound down by exudate or a blood clot, so that in the case of a small foreign body the magnet cannot dislodge it, or if it is larger and



Fig. 3 (Sherman). Roentgen localization of piece of steel 57 mm. long. Anterior end in right orbit, posterior end in left sphenoid sinus.

does respond to the magnet the tissue or structure to which it is adherent may be damaged. Würdemann<sup>9</sup> says that "Early extraction is essential even though exact localization has not been made." Occasionally, after an eye has been struck by a very small particle of steel, it is not easy to determine without a most careful examination whether there has been a perforation. There may be no pain or redness, and the vision may be good. This is illustrated by a case seen a few months ago. A man while striking a tool with a hammer felt something strike his eye. I saw him an hour or two

later, but could find no wound or other evidence of injury, and the vision was 20/20. There was no pain. As a precaution, a mydriatic was used. I could then see a small opacity in the extreme upper part of the lens, and a chip of steel not over a millimeter in size lying on the lower half of the retina. A further search then disclosed a very small, almost invisible wound in the limbus.

Another man with a similar history had what looked like a superficial wound in the lower part of the cornea and a tiny, dark spot on the iris which looked like pigment, almost out of sight in the iridocorneal angle. With the slitlamp it could be seen that the wound was a perforation and that the dark spot was a piece of metal. Injuries of this type are not infrequently overlooked until months later, when cataract develops, siderosis, or other sequelae. I have encountered several such cases in which an earlier X-ray report was negative.

I can recall no case in which, following a recent accident, a foreign body was demonstrated by the X ray or other means to have been within or to have passed through the eye, and in which evidence of perforation could not have been discovered by an ordinary careful clinical examination. I do not want to be understood as depreciating the value of the roentgen examination. What I would emphasize is, that while it is often useful or even a necessity, it should not be depended on to furnish or confute evidence readily available by the use of our own senses or office armamentarium. This is, of course, true concerning other laboratory aids to diagnosis in various fields of medicine. A reliable history of the accident giving information as to the size, velocity, and chemical composition of the particle is often an aid in deciding when and how to proceed.

In the case of a recent wound of the

eyeball, particularly if the media are cloudy, it is sometimes difficult to determine whether a foreign body has struck the eye and rebounded, or is within the globe or orbit. Here the X ray will usually furnish accurate information, besides indicating the approximate size and shape and location of the object. If, after a negative roentgen report, there is still some doubt, the magnet may be used. This is the only situation in which its use for diagnostic purposes is permissible. A possible exception is when a foreign body of unknown material can be seen in the anterior chamber or iris; the magnet may be used to determine whether it is magnetic. When there are indications that the foreign body is very small, the roentgenologist should be informed, so that he may take extra care with his technique and examination of the films.

Pictures of the Haab technique for removing a foreign body from the globe show the patient seated before the giant magnet, which is mounted on a stand. Lacking better facilities, I have many times removed a foreign body by this method and have experienced the difficulties with which many are doubtless familiar. We now have the operating room equipment so arranged that the Haab magnet, when needed, can be used with the patient on an operating table with his head under perfect control, although with the Sweet and smaller Lancaster magnets available, the larger magnet is required less frequently.

Foreign bodies in the anterior segment are usually small, and the wound in the cornea usually closes quickly. Consequently, if aqueous has been lost, the anterior chamber is soon restored and the foreign body, if magnetizable, can, as a rule, be easily maneuvered with a hand magnet to the point selected for its exit. Contrary to the advice of some surgeons,

including Verhoeff,<sup>10</sup> I prefer to remove it through a keratome incision in the limbus *above* rather than *below*, because in some cases even with a well-dilated pupil, entanglement in the iris occurs, necessitating an iridectomy. A coloboma in the upper part of the iris causes comparatively little disability or disfigurement, but when it is below, it is unsightly and, what is more important, the resultant dazzling is persistent and very troublesome. Before attempting magnet removal of a foreign body from the anterior chamber, the pupil should be well dilated. The importance of this has been emphasized by Barkan,<sup>11</sup> Evans,<sup>12</sup> and others. For this purpose 3 or 4 drops of 1:1000 epinephrine subconjunctivally, or a drop or two of a 1:100 solution on the cornea are preferable to atropine. With the former, prolapse of the iris is less likely to occur, and the mydriasis can be more quickly reduced with a miotic, when this is indicated. Concerning the incision, Verhoeff<sup>10</sup> mentions a precaution which I have learned from experience is important. He advises that the point of the keratome be entered as far back from the limbus as possible, without danger to the lens or the iris. If the incision is too far forward, the corneal-scleral shelf may prevent the foreign body from entering the wound. I have made this error, and the ensuing difficulty in removing the foreign body was considerable. In dealing with particles of steel in the anterior chamber, whether they have remained there or have been drawn forward from the vitreous, it should be remembered that a good hand magnet has almost as much attracting force at short range as a large one, and, as it is more easily manipulated, is much safer.

Whether it is safer to remove a foreign body from the vitreous by the anterior route, or through an incision in the

sclera, has been a subject of controversy since the days of Haab and Hirschberg.

Among recent writers on the subject, Verhoeff<sup>10</sup> advocates the anterior route. He says, "For many years I have accepted the teaching of Haab that the safest way to remove a magnetic foreign body from within the eye is through the anterior chamber. Those who advocate removing it through a posterior scleral incision are, I believe, influenced by the fact that the method is simpler and does not require so powerful a magnet. The danger of subsequent separation of the retina is undoubtedly far greater after a scleral incision, and for this reason the posterior route, in my opinion, should never be used unless it is found impossible to bring the foreign body from behind the lens, or there is a large open wound in the sclera." Walter F. Duggan,<sup>13</sup> after reviewing the results in 270 cases from the records of the Knapp Memorial Hospital, concludes that "A scleral wound (operative or accidental) seems definitely to favor the development of a detached retina, a vitreous exudate, or both. It should be used only when other methods of removing a foreign body fail."

On the other hand Stieren,<sup>14</sup> who at the time of writing had performed more than 700 magnet extractions, does not use the anterior route at all, and claims satisfactory results by a scleral incision and direct removal of the foreign body from the vitreous. Numerous other writers, such as Allport, Shoemaker, Deschweinitz, and Sweet, prefer the posterior route. Sweet<sup>15</sup> said, "Retinal detachment is not a logical result of a scleral incision for the extraction of a foreign body from the vitreous chamber. The exudation associated with a long-retained foreign body is probably a more frequent cause of detachment."

Formerly, I removed or attempted to remove particles of steel from the vitre-

ous through the anterior chamber, according to the method of Haab, but during the past 20 years have been using the posterior route with increasing frequency. One reason is that we are better equipped with small magnets and other facilities; furthermore, the results have justified the change. At present, my practice is as follows: If the foreign body has entered through the limbus or sclera I prefer, in most cases, to remove it through an incision in the sclera located near the foreign body, as indicated by ophthalmoscopic or roentgen examination. If the wound of entrance has not closed, it is sometimes better to use that, enlarging it if necessary, rather than a new incision. If the foreign body is small and has passed through the cornea and lens, especially if it is in the anterior part of the vitreous, a safer method is to bring it forward rather than make an incision in the sclera. In some cases the eye is so badly injured that the only thing to do is to get the foreign body out as easily as possible. This will usually be through the wound of entrance.

The following procedure has been satisfactory for removing particles of steel through a scleral incision: After exposing a sufficient area of sclera, two fine silk sutures are placed, 2 mm. apart, superficially in the sclera, usually, but not always, as near as possible to the location of the foreign body. The sclera is then incised meridionally between the sutures, care being taken not to cut the choroid. The length of the incision is based on the estimated size of the foreign body. The conical tip of the Lancaster hand magnet or a larger magnet is brought gradually in contact with the wound, the edges of which are then separated by traction on the sutures.

By thus retracting the edges of the wound at the proper time, a foreign body

can often be removed through a smaller incision than without this aid, and with little or no loss of vitreous. Traction is relaxed as the foreign body emerges. As the choroid begins to bulge the foreign body usually perforates it. If not, it must be incised. The sutures are also an aid in steadying the eye. Phenobarbital given two or three hours before, if time permits, morphine hypodermically an hour before the operation, and akinesia of the orbicularis make the operation safer and easier. A foreign protein, preferably typhoid vaccine intravenously, given immediately before or after the operation, is a safeguard against infection.

In all cases one should endeavor to stir up or injure the vitreous as little as possible. Injudicious attempts to remove a foreign body from the vitreous by the introduction of magnet tips and other instruments are likely to do more harm than good, and probably account for many of the cases of detachment of the retina and other serious sequelae which have been reported.

There are some instances when it is probably better not to attempt to remove an intraocular foreign body. This is a decision which sometimes must be made in the case of a long-retained foreign body that is inactive, and the attempted removal of which is likely to damage the eye seriously. Bulson, several years ago, discussed this subject and cited a number of cases of retained intraocular foreign bodies that remained innocuous for years. However, these cases are rare, and they should not be cited as an excuse for not making every reasonable effort to remove a foreign body, particularly recent ones, unless the chances are that the damage caused by its removal will be greater than that of its retention.

671 Broad Street.

## REFERENCES

- <sup>1</sup>Allport, F. Amer. Jour. Ophth., 1925, v. 8, p. 483.
- <sup>2</sup>Davidson, M. Amer. Jour. Ophth., 1933, v. 16, p. 331.
- <sup>3</sup>— Industrial Medicine, 1939, April.
- <sup>4</sup>Mayou, S. Trans. Ophth. Soc. U. Kingdom, 1925, v. 45, p. 192.
- <sup>5</sup>Vogt, A. Atlas der Spaltlampenmikroskopie des lebenden Auges. Ed. 2, v. 2, p. 642.
- <sup>6</sup>Kiehle, F. A. Arch. of Ophth., 1932, Feb., p. 180.
- <sup>7</sup>Lancaster, W. B. Amer. Jour. Surg., 1938, Oct., p. 14.
- <sup>8</sup>Bane, W. C. Trans. Sect. on Ophth., Amer. Med. Assoc., 1929, p. 151.
- <sup>9</sup>Würdemann, H. V. Injuries of the eye. Ed. 2, p. 339.
- <sup>10</sup>Verhoeff, F. H. Amer. Jour. Ophth., 1932, v. 15, p. 685.
- <sup>11</sup>Barkan, Otto and Hans Amer. Jour. Ophth., 1927, v. 10, p. 919.
- <sup>12</sup>Evans, W. H. Industrial Med., 1937, Nov.
- <sup>13</sup>Duggan, W. F. Arch. of Ophth., 1933, Dec., p. 768.
- <sup>14</sup>Stieren, Edw. Amer. Jour. Ophth., 1932, v. 15, p. 1120.
- <sup>15</sup>Sweet, W. M. Trans. Sect. on Ophth., Amer. Med. Assoc., 1906, p. 370.

## VISUAL-ACUITY TESTS\*

SAMUEL S. BLANKSTEIN, M.D.

*Milwaukee, Wisconsin*

AND

MARY JANE FOWLER, M.D.

*Chicago*

The use of the Betts test\*\* as a method of visual testing in schools has increased considerably in the past few years, but no data have been presented in the ophthalmological literature as to its relative accuracy. A comparison of its individual components comparable to standard ophthalmic tests would seem to be necessary before any ophthalmologist could advise educators as to their use. This study was made to evaluate only the relative accuracy of the visual-acuity portion of the Betts test, as compared with a standard Snellen chart. Later we intend to evaluate the other portions of the test. The only report in the ophthal-

mological literature is a study by Hitz† on a group of 32 children. A total of 48 tests for visual acuity by a Snellen chart with uniform illumination and the Betts test for visual acuity showed that the two tests agreed in 74 instances or 77 percent. A 20-percent difference was allowed, using the industrial percentages of visual-loss tables, as adopted by the American Medical Association.

Our study consisted of a comparison of the two tests; namely, a standard Snellen chart with uniform illumination at 20 feet, and the Betts cards for visual acuity used in the stereoscopic apparatus and illumination as provided by the manufacturer. The results can be divided into two groups. One group was tested in the clinic and consisted of adults ranging in age from 16 to 60; the other group con-

\* From the Division of Ophthalmology, Department of Surgery, the University of Chicago; E. V. L. Brown, director. Research aided by a grant from the Keystone View Company.

\*\* Cards DB1, DB2, DB3 of the Keystone diagnostic series were used, as supplied by the Keystone View Company.

† Hitz, J. B. Amer. Jour. Ophth., 1938, v. 21, p. 1024.

sisted of children tested in a graded school‡ under similar conditions. The age limits were from about 7 to 12 years.

It was decided in making a comparison of the two tests to use the Snellen rating as a basis and not the "visual efficiency" percentages designed primarily for industrial purposes. Practically all visual acuities are now recorded by ophthalmologists in some form of Snellen decimals or fractions, such as 20/20, 1.0, or 6/6. The distribution of the dots of the Betts cards for visual acuity is convenient, as far as visual-efficiency percentages are concerned, because they progress numerically uniformly from 20 to 110 percent. How-

In making a comparison of the results of the two methods of determining visual acuity, the amount of error allowed obviously affects the final result. Our figures have been interpreted and tabulated by the use of two different allowances. The first results were obtained by allowing only a difference of anything less than 0.1 up to 0.6 vision, and 0.2 up to 1.2 vision as represented on the Snellen chart. Thus the allowance is anything less than a full line on the Snellen chart. Snellen 1.2 and 1.5 were considered equivalent to 1.3 on Betts cards. For example, if a patient obtained dot no. 7 or 0.44 on the Betts test, and 0.6 on Snellen chart, this was con-

TABLE 1  
COMPARISON OF VISUAL-ACUITY RATING CHARTS\*

A.M.A. rating†	20%	30%	40%	50%	60%	70%	80%	90%	100%	105%	110%
Snellen-letter-chart values	0.1 = 20/200	0.13 = 20/150	0.16 = 20/122	0.2 = 20/100	0.27 = 20/75	0.33 = 20/60	0.44 = 20/45	0.6 = 20/33	1.0 = 20/20	1.3 = 20/15	2.0 = 20/10
Betts Test-Card‡ (dot arrangement) Values	1	2	3	4	5	6	7	8	9	10	11

\* According to Keystone View Company Publications.

† Section on Ophth. A.M.A. 1925, p. 370.

‡ Each successive number represents a higher visual acuity.

ever the distribution coincides only fairly well with the lines on a standard Snellen chart (see table 1).

The Snellen chart used by us progresses evenly from 0.1 to 0.6 in 0.1 steps, jumps to 0.8, then to 1.0, 1.2, 1.5, even 2.0 in some cases. However, the Snellen comparison of the Betts cards goes from 0.1 to 0.6 inclusive in eight steps, the interval between them becoming larger. It then jumps from 0.6 to 1.0. Thus it is obvious that a comparison with Snellen ratings is apt to lead to error because of the considerable jump between 0.44 to 1.0 Keystone; that is, dots 7 and 9, between which there is only one division.

‡ The University of Chicago Elementary School.

considered a plus value in favor of Snellen chart because there was at least 0.1 or more difference. Similarly 0.6— on the Snellen chart as compared to 0.44 on Betts cards was also considered a plus value. If the Snellen chart showed 0.5, 0.5— or 0.5+ this was considered as corresponding to no. 7 dot or 0.44 on the Betts card because 0.5, 0.5— or 0.5+ was not a whole line or a full 0.1 difference. The plus sign was added to a Snellen chart value where the patient obtained less than majority of the letters of the subsequent line. Where more than the majority, but not the total number of letters of that line were attained, a minus sign was attached to the value of that line.

The second results were obtained in

cases in which a larger allowance was made. The difference allowed was a full (total) line or 0.1 difference for Snellen vision 0.6 or less. An allowance of 0.2 was made for vision between 0.6 and 1.2. Snellen 1.2 and 1.5 were considered equivalent to 1.3 and 2.0 on Betts cards, respectively. Also 1.5 on the Snellen chart and 1.3 on the Betts cards were considered equivalent. More than one whole line of difference was considered necessary for a disagreement. If the Snellen chart showed 0.8 and Betts cards 0.6, this was considered as an agreement of values, but an 0.8+ on the Snellen chart was considered a plus Snellen value as compared to 0.6 on Betts cards. An 0.5 Snellen-chart value would still be in agreement with an 0.6 on Betts cards, but 0.5- on Snellen chart gave a minus Snellen value as compared with 0.6 on Betts cards, because there is more than 0.1 difference between the two values.

In taking these Snellen-chart visions, the patients were not "pushed" or coerced but were given enough time to read the individual letters that were pointed out to them. It was definitely noticed that vision of an individual eye was somewhat better if the other eye was closed by the subject's finger or if he voluntarily closed the lid. With both eyes open and using a white card for a cover over one eye, the vision of the other eye appeared somewhat blurred. The factor of suppression or of a blur may be introduced in this manner. Use of a black card or paper was not attempted to see if that would reduce the interference.

In this connection a similar suppression factor arose very strikingly in the use of the Betts cards. When the Betts stereoscopic cards were used, with the black dots within the white diamonds presented to only one eye while the other eye viewed only the white diamonds, the visual acuity of the eye viewing the black

dots would immediately rise one or more smaller dots on occluding the view of the other eye with a card so that the chamber in front of that eye became considerably darkened. This occurred in 24 percent of the individual eye examinations of adults and in 39 percent of individual eye examinations of children. One might expect this to be especially true where one eye was amblyopic and suppression played a considerable part. However, it occurred very often where vision was ultimately normal both by Betts cards and Snellen chart tests. The occlusion procedure was used in every case in which the vision in the individual eye when the dots were presented to only one eye (although both eyes were open) was lower than the vision of both eyes when the dots were presented to each eye. The best vision obtained was the figure used in our final tabulations. It occurred to us that this suppression might be related to the problem of the master eye and corresponded closely in a few cases; but too few were tried to allow any definite conclusions to be drawn. This is to be further investigated. The phenomenon is closely related to that which occurs when Snellen-chart vision is taken with one eye covered by a white card. Of course the stereoscopic cards allow a higher degree of suppression to take place.

We feel that as far as visual-acuity estimations were concerned, one method is as rapid as the other. The time consumed in reading more letters on the Snellen chart than there are dots on the Betts cards is equaled by the time necessary to explain what is wanted from the stereoscopic slides. Naturally, to older children and those who had previously had this test, such explanations were unnecessary, but this, in turn, was balanced by the many pupils who could read the 1.5 Snellen chart line at the outset. The new and strange features of the Betts cards

somewhat confused some second- and third-grade children who rapidly responded to the familiar letters of the Snellen test.

## RESULTS

### ADULT GROUP (see table 2)

*First results:* (see allowances above)

A record was made of 466 visions; 310 were of individual eyes and 156 records were of examinations made when both eyes were in use at the same time. Of the 310 individual eyes examined agreement was noted in 171, or 55 percent. Eighty-

A further analysis of the results showed that of the 310 individual eyes examined, 195 had a Snellen-chart vision of 1.0 or over and 115 had a vision of less than 1.0. Of those with 1.0 vision and over, there was agreement of visual acuity values in 64 percent of cases, 24 percent gave a higher Snellen-chart value, and 12 percent gave a lower Snellen-chart value. Of those with less than 1.0 vision, only 40 percent were in agreement, 26 percent gave a higher Snellen value, and 24 percent a lower Snellen value. Obviously the Betts cards were more discriminatory for visions less than normal,

TABLE 2  
COMPARISON OF SNELLEN-CHART AND BETTS-CARD VALUES

*First Basis: allowance of less than a full line on Snellen chart*

	Adult Group		Child Group	
	Single Eye	Both Eyes	Single Eye	Both Eyes
Number of eye examinations	310	156	614	306
Percentage in agreement	55%	60%	57%	51%
Percentage with higher Snellen-chart value	29%	18%	19%	26%
Percentage with lower Snellen-chart value	16%	22%	24%	23%
<i>Second Basis: allowance of a full line on Snellen chart</i>				
Number of eye examinations	310	156	614	306
Percentage in agreement	67%	78%	75%	69%
Percentage with higher Snellen-chart value	23%	13%	10%	11%
Percentage with lower Snellen-chart value	10%	9%	15%	20%

nine, or 29 percent, gave a higher visual acuity; 50, or 16 percent, gave a lower visual acuity with the Snellen chart. With both eyes, 156 examinations showed that 94, or 60 percent, were in agreement; 29, or 18 percent, gave a higher value; and 33, or 22 percent, gave a lower visual acuity with the Snellen chart. Hence, with individual-eye examination the Betts test is more discriminatory than the Snellen chart, but with both eyes the reverse is true. The total group of 466 visions showed 57 percent in agreement, 25 percent with a higher, and 18 percent with a lower Snellen-chart value.

and corresponded less to Snellen-chart values. Of the 156 binocular examinations, 119 had 1.0 and over and 37 had less than 1.0. Those with vision 1.0 and over had an agreement in 66 percent of the visions, 15 percent had a higher, and 19 percent a lower Snellen value. Of visions less than 1.0 only 40 percent were in agreement, 30 percent had a higher, and 30 percent a lower Snellen-chart value.

*Second results:* (see allowances above)

Of the 310 individual eyes examined, 67 percent were in agreement, 23 percent gave a higher, and 10 percent a lower

Snellen-chart value. When both eyes were open, in 156 examinations there was agreement in 78 percent, 13 percent gave a higher, and 9 percent a lower Snellen value. The composite figures of 466 visual acuities showed agreement in 71 percent of cases, 20 percent gave a higher, and 9 percent a lower Snellen value. Thus we can see there is considerably more agreement where more allowance was made. Here a full line of Snellen was allowed.

#### CHILD GROUP (see allowances above)

Of 920 visual-acuity estimations, 614 were individual eyes examined and 306

of 132 individual-eye examinations on second-grade pupils with 136 individual-eye examinations on sixth-grade pupils showed that 53-percent agreement occurred with second-grade students and 58-percent with sixth-grade students. This small difference we believe to be within limits of practical error and shows again that age is not a factor from the second grade up. No attempt was made to incorporate kindergarten or first-grade pupils, because teachers and school physicians had failed to obtain satisfactory visions by either method, and it was thought that the time spent would not produce results accurate enough for this study.

TABLE 3  
VISUAL ACUITIES

	Single Eyes		Both Eyes	
	Snellen Chart	Betts Cards	Snellen Chart	Betts Cards
<i>Adult Group</i>				
Eyes examined	310	310	156	156
Percentage (normal = 1.0)	63%	66%	76%	81%
Percentage less than normal	37%	34%	24%	19%
<i>Child Group</i>				
Eyes examined	614	614	306	306
Percentage (normal = 1.0)	79%	82%	90%	84%
Percentage less than normal	21%	18%	10%	16%

binocular. Of the 614 individual eyes examined, 57 percent were in agreement, 19 percent had a higher, and 24 percent a lower Snellen-chart value. Of the 306 with both eyes examined, 51 percent were in agreement, 26 percent gave a higher, and 23 percent a lower Snellen-chart value. Practically speaking, the individual-eye examinations corresponded to those of the adult group with the same allowances. The binocular examinations corresponded within 9 percent. Apparently age is no factor in determining the results. Here the Snellen chart was more discriminatory, for there were lower Snellen values than Betts values. A comparison

#### Second results: (see allowances above)

Of the 614 individual-eye examinations, 75 percent were in agreement, 10 percent gave a higher, and 15 percent a lower Snellen value. The 306 binocular visual examinations showed 69 percent in agreement, 11 percent with a higher, and 20 percent with a lower Snellen value. Again a similar rise in the percentage of agreement occurred in the child group; however, the rise was greater by almost 6 percent in the individual-eye examinations than in the adult group. Consequently, it can be seen that with what is considered a fair allowance, the greatest agreement of individual-eye examination was 67

*percent in the adult group and 75 percent in the child group.* With both eyes, 78 percent in the adult group and 69 percent in the child group were in agreement.

A calculation of the percentage of visual acuities that were found to be normal with the Snellen chart as compared with Betts cards showed very close agreement, taking 1.0 vision as being normal (table 3). In the adult group, 63 percent of the individual eyes examined with the chart were 1.0 and over, 37 percent less than 1.0; with the Betts cards 66 percent were 1.0 and over, and 34 percent less than 1.0. The agreement shows only a difference of 3 percent in the figures, an error of only about 4.5 percent. Where both eyes were examined, 76 percent were normal with Snellen chart and 81 percent by Betts cards, a difference of 5 percent or an error of almost 7 percent. In the child group of 614 individual eyes examined, the Snellen test showed 79 percent with normal vision and the Betts cards 82 percent, a difference of only 3 percent, or an error of almost 4 percent. With both eyes open, 90 percent had normal vision using the Snellen chart and only 84 percent using Betts cards, a difference of 6 percent or an error of 6.6 percent. Thus in determining normal visual acuity they are in good agreement. The second-grade pupils showed 72 percent normal vision with Snellen chart, 75 percent with Betts cards, thus showing that as compared with the total group, there were 7 percent fewer individual eyes with less than normal vision, indicating that more children with normal visual acuity were found in the higher grades. The Betts tests in all these instances gave higher

values, thus showing that Snellen charts were more discriminatory in this type of screening test.

#### SUMMARY

A proper interpretation of a comparative study of the visual acuities obtained by Betts stereoscopic cards and Snellen visual charts is difficult. Different allowances gave a rather marked difference in results. With what was considered a fair allowance the visual acuities of the individual eye were in agreement in only 67 percent of the tests in adults, and 75 percent in children. Thus the Betts visual-acuity tests are not an accurate measure of the visual acuity as compared with the Snellen charts, and especially in individuals with subnormal vision. Age was not a contributing factor in determining the results of this study in either method from the second grade upwards. The Betts tests were not used for children below the second grade; that is, in children younger than about eight years of age. However the illiterate Snellen E chart is satisfactory for children even as young as four years of age. We believe one method is no faster than the other, on the whole. In adults the Betts cards were found to be slightly more discriminatory. As a screening test for determining whether vision was normal, the Snellen charts were only slightly more discriminatory, but the two were in close agreement. Thus neither test has any particular advantage over the other when used to determine whether vision is normal or not. The Betts cards introduced a high degree of suppression and this was only a small factor in the use of Snellen charts.

## A CASE OF RHINOSPORIDIUM OF THE CONJUNCTIVA\*

WILLIAM BANKS ANDERSON, M.D., AND THOMAS H. BYRNES, M.D.

*Durham, North Carolina*

Below are presented observations on what is apparently the first reported case of ocular Rhinosporidiosis to occur in North America. Rhinosporidiosis is a disease of the mucous membranes characterized by the formation of peculiar and distinctive polypi. Formation of these polypi is excited by the invasion of the mucous membranes by an organism that has been studied by Ashworth<sup>1</sup> and assigned to the lower fungi (Phycomycetes), suborder Chytridinæ, provisionally placed near the Olpidiaceæ. This particular fungus was originally isolated from a nasal polyp by Guillermo Seever in Buenos Aires in 1896. It was rediscovered by Major O'Kinealy of the Indian Medical Service in 1903. The disease has been described as occurring in man, cattle, and horses. It has been reported from Asia, the Philippine Islands, North and South America, from Africa, and from Europe. It seems probable that the distribution is much wider and that the disease is much more common than one would suppose from the small number of cases that have been reported to date. It is probable that many cases are being overlooked. The mode of infection is not known, but transmission either by dust or water into a previously traumatized area appears to be most probable. Transmission through the handling of infected horses, cattle, pets, and other animals, has been suggested.

Textbook descriptions of the occurrence of this disease in the eye are extremely brief. Duke-Elder<sup>2</sup> has given only about one page to a discussion of this

very rare infection. He states that all reported cases have come from India. The disease could not be found listed in the index of the "Kurzes Handbuch der Ophthalmologie," although possibly it has been indexed under some other name. McKee<sup>3</sup> in a recent textbook devotes about one-fifth page to this condition and indicates that all cases have been reported from India.

The first conjunctival polyp known to be due to the Rhinosporidium was observed and reported by Kirkpatrick<sup>4</sup> at Madras in 1909. Elliot and Ingram<sup>5</sup> reported on a conjunctival form in 1912; Tirumurti<sup>6</sup> in 1915; Wright<sup>7</sup> in 1922; Duggan<sup>8</sup> in 1928; Kurup<sup>9</sup> in 1931; Rao<sup>10</sup> in 1931; and Kaye<sup>11</sup> in 1938. Kaye reported from South Africa; all other reports were from India. Recently reports of nasal polypi due to this organism have been reported in Texas.<sup>12</sup> A total of seven cases of nasal polypi due to the Rhinosporidium have been reported in the United States according to the article of Caldwell and Roberts cited below.<sup>12</sup>

We therefore feel justified in calling attention to the invasion of ocular tissue by this organism. We may be reporting only a medical curiosity; on the other hand, the type of lesion is such that it may easily be overlooked in a busy office practice, where many small granuloma of the conjunctiva are being excised and discarded without arousing suspicion as to the etiology of the disease. The disease is probably much more common than has hitherto been supposed, and it is anticipated that if a conscientious search is made of many of the small granulomata that occur on the conjunctiva more of these cases will be found. In view of the difficulty in eradicating

\*From the Department of Ophthalmology, Duke University Hospital, and the Pathological Laboratory of the Watts Hospital.

the focus, recognition of the true nature of the disease may assume some practical significance. Sections of our tissue were submitted to Captain DeCoursey and Colonel Ashe of the Army Medical Museum, who concurred in the diagnosis. It was our understanding at the time these slides were submitted that no other cases of ocular Rhinosporidiosis had been registered in the Army Medical Museum.

The infection observed by us occurred in a 12-year-old Negro boy, who presented himself in February, 1938, with a history that for the past 12 months he had noticed a growth on the lower lid of his left eye which, while growing slowly, had now reached the point at which it interfered with closure of the lid. The growth was first observed by the patient in December, 1937. There was no history of previous trauma nor of any similar infection or growth in any of his immediate associates. During the first six years of his life he had lived on a farm in the eastern part of North Carolina, but for the past six years had lived in the city of Durham. He had not been associated in any way with pets, horses, cattle, or agricultural pursuits.

Examination revealed an irregularly lobulated, pinkish-red growth extending or protruding from beneath the lower lid near the external canthus. This growth was definitely pedunculated and attached in the fornix by a broad base. It measured roughly 8 by 4 by 2 mm. There was some lacrimation but no other evidence of irritation. On casual examination it resembled very much the fungoid granulation which one sometimes sees following the curettement of chalazia, and it was first presumed that such was the nature of this lesion. However, due to the fact that it was somewhat more firm, more vascular, and more definitely lobulated than is seen ordinarily in the granulations that occur following such procedures, the

specimen was sent to the Pathological Laboratories after excision. At the time of the removal of the tumor, there was no suspicion of the true nature of the lesion.

The pathologist reported as follows:

The gross specimen is a small, polypoid piece of tissue, 2 by 5 by 8 mm. in size, with a slightly granular outer surface. It is pinkish-white in color, solid but moderately soft, and of uniform consistency, with a few small, yellowish-white areas on the cut surface.

Microscopically, this tissue has a covering of stratified squamous epithelium which is lost in many places where there are superficial ulcerations; and the epithelium dips down to form an occasional cryptlike structure, filled with neutrophilic polymuclear leukocytes. Toward the base, the stroma is of a fairly cellular fibrous tissue, infiltrated with leukocytes, mostly plasma cells. Extending away from this, the stroma has a very scanty cell structure, and the tissue spaces are choked with plasma cells, neutrophilic polymuclears and eosinophiles. There are a few small, compact masses of neutrophilic polymorphonuclear leukocytes, suggesting miliary abscesses. Diffusely scattered through the tissue, for some distance beneath the epithelium, are numerous sporangia of very variable size (figs. 1 and 2), most of which are empty, but some contain a few endospores. Giant cells of the foreign-body type are found about the periphery of a few sporangia. These sporangia have the morphology of *Rhinosporidium seeberi*, and the inflammatory reaction is like that caused by this organism.

The following is the concurring diagnosis of the Army Medical Museum pathologists:

*Microscopic:* The section shows conjunctival epithelium covering a stroma in which there is a large area of leukocytic and mononuclear exudate around spores that are from about 15 to 120 microns in diameter. With the H & E stain, most of the organisms show a slightly eosinophilic, hyalinlike, refractile capsule about 5 mm. thick. Each capsule surrounds a foamy granular material whose center contains an ovumlike structure with a pseudogranular protoplasm and a slightly eccentrically placed, rounded, basophilic body about one third the diameter of the ovumlike structure (fig. 2). One large ruptured organism with a much thicker capsule is adjacent to recently discharged endospores, each of which would seem to begin a new cycle of enlargement with subsequent multiple endospore formation.

Numerous polymorphonuclear and eosinophilic leukocytes are in the exudate surrounding this ruptured organism. In other places plasma cells are more abundant than polymorphonuclear leukocytes. The reaction extends into the epithelium, which occasionally contains an organism. The surrounding stroma is quite vascular and the endothelial lining cells are somewhat swollen. This lesion both from the morphology of the organism and from the cellular reaction appears to be the result of *Rhinosporidium seeberi*, and as far as I know is the first case of Rhinosporidiosis of the conjunctiva in North America.

*Diagnosis:* Rhinosporidiosis, conjunctiva.  
Report by Captain Elbert DeCoursey.

The cases reported by the Indian observers and the one here reported have the following characteristics in common: The duration of the disease was usually about one year. The lesion was painless, the patient coming in for relief of mechanical obstruction to lid closure. The preauricular gland was not enlarged. The conjunctival polyp averaged in the fresh state 8 by 4 by 4 mm. In the nose the polyp was said to have long, fingerlike processes having semitransparent edges and a band of fibrous tissue running down the middle like the midrib of a leaf. In the conjunctiva the picture was a modification of the nasal form. It was described by one author as having the appearance of a discolored strawberry. Another compared it to a gelatinous "cockscorn." Dilated tortuous conjunctival vessels were observed coursing over the mass in all cases.

Allen and Dave<sup>13</sup> studied 60 cases of this disease. It occurred 56 times in the nose, and 4 times in the conjunctiva. These authors state that in all cases the polypi presented similar microscopic and histological features. First, the finding of a villous polypus which usually appears wholly or in part composed of granulation tissue that bleeds readily when touched, should arouse suspicion. Then on examination with the loop, one sees a

fleshy growth covered by vascular glistening conjunctiva, with just beneath the surface the typical characteristics of the numerous yellowish-white specks vividly contrasting with the red background. For diagnostic purposes it is suggested that if the growth under investigation is gently squeezed with a pair of light flat forceps and the blades then rubbed into a drop of saline on a slide, a cover slip placed over it, and the preparation examined under low power of the microscope, the characteristic sporangia will be evident. Alternatively, the preparation may be stained by a Romanowski stain, and the spores containing the characteristic spherules will be seen.

Microscopically the polypus proper is said to be covered by an irregularly thick layer of epithelium, which is continued into and forms the lining of numerous branching cryptlike bases extending deeply into the substance of the growth. The stroma in the central portion of the polypus consists of cellular connective tissue which, in some parts, is infiltrated by chronic inflammatory cells. The peripheral part of the stroma, especially that lying subjacent to the epithelium, is largely replaced by chronic inflammatory granulation tissue and pus cells, and some of the cryptlike spaces contain pus. The predominant inflammatory cell is the plasma cell. The mature sporangia tend to find their way through the epithelial layer, and numbers are frequently seen lying free in the crypts and frequently the sporangia are seen in the act of discharging spores.

In a report of this disease in the British Journal of Ophthalmology, 1928 volume 12, page 526, Major J. N. Duggan, professor of ophthalmology of the Grant Medical College of Bombay, confirms the microscopic description of Allen and Dave, summarized as follows:

The *Rhinosporidium* affects stratified epithelium; it forms cysts of various sizes, 3 to 4  $\mu$ . in diameter, containing 8 to 15 spores and lined by flat epithelium. The cysts burst, discharging spores. After they have gone, the cyst is then invaded by leukocytes. Microscopic sections contain a fair amount of fibrous and

description of the tissue studied in the case reported by Elliot and Ingram, concurring in essential points with the transcriptions above:

The conjunctival polypus removed from be.



Fig. 1 (Anderson and Byrnes). Showing number and disposition of cysts within polyp ( $\times 32$ ). Compare with figure 3 reproduced from Kirkpatrick (plate 8).

fibrocellular tissue (granulation tissue rich in plasma cells), and typical cysts of *Rhinosporidium*. The cysts are situated in the subepithelial layer and are irregular in size, shape, and distribution according to the different stages of the growth. Some contain granular material while others are quite empty.

The following is the pathologist's de-

neath the cutaneous growth: This consists of fibrous and fibrocellular tissue containing a considerable number of typical cysts of *Rhinosporidium kinealyi*. These were of all sizes and were irregularly scattered throughout the tissue. The surface of the polypus was covered with an irregular layer of transitional epithelium; and close to the surface were a large number of cystic spaces full of granular ma-

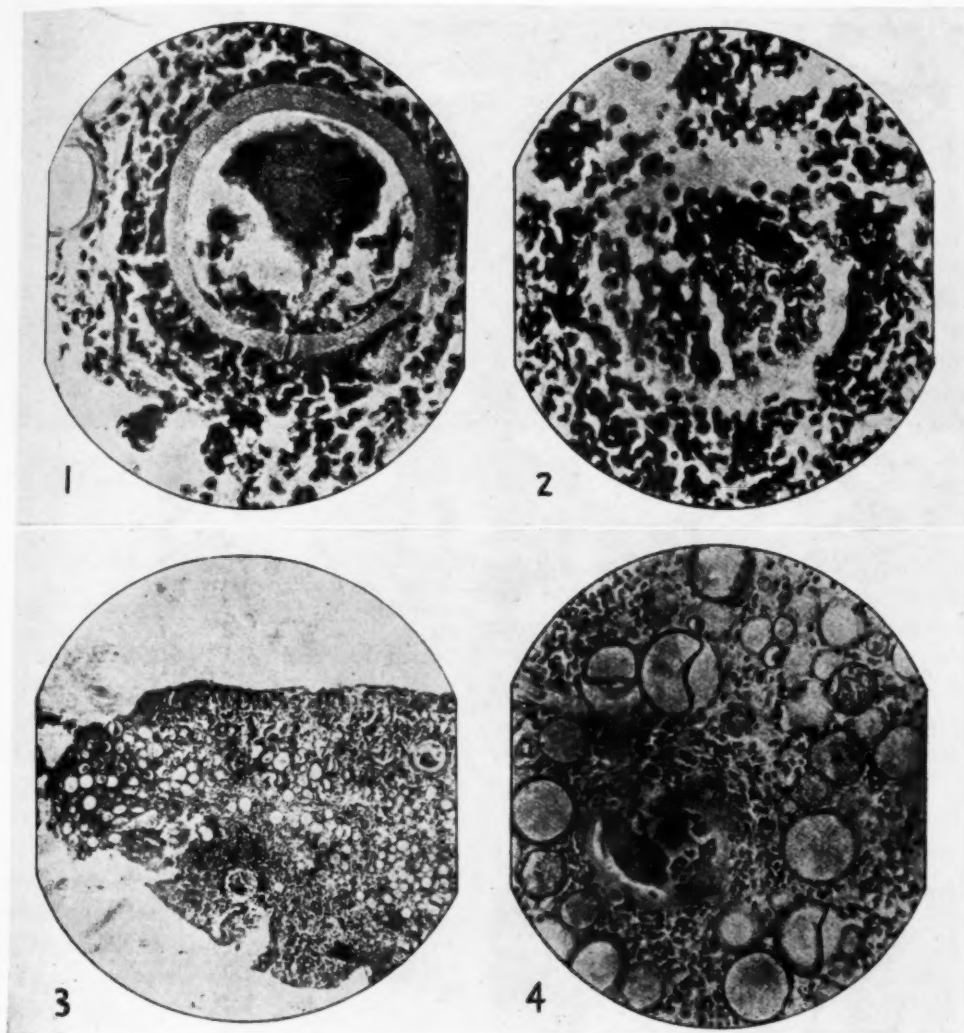


PLATE 8. REPRODUCTIONS FROM ARTICLE BY KIRKPATRICK CITED BY ELLIOT AND INGRAM (OPHTHALMOSCOPE, 1912, V. 10, P. 428).

FIG. 1. CYST EMPTIED OF SPORE MORULAE AND INVADDED BY CONNECTIVE-TISSUE CELLS. GIANT-CELL FORMATIONS. NOTE APPEARANCE SUGGESTIVE OF A PORE IN CYST WALL (ABOUT  $\times 700$ )

FIG. 2. CYST FROM WHICH SPORE MORULAE ARE ESCAPING INTO SURROUNDING GRANULATION TISSUE. THE CYST WALL IS DEGENERATING (ABOUT  $\times 700$ )

FIG. 3. SHOWING LARGE NUMBER OF CYSTS ON THE OUTER SURFACE OF GROWTH (ABOUT  $\times 100$ ).

FIG. 4. YOUNG GRANULATION TISSUE CONTAINING CYSTS IN VARIOUS STAGES. A LARGE CYST IS UNDERGOING ORGANIZATION (ABOUT  $\times 450$ ).

1  
4  
684

teri  
by  
fro  
con  
lar  
mo

A  
or  
T

sim  
ary  
rec  
men  
thes  
war  
gro  
fici  
poly  
tion  
of  
uns  
men  
cau  
of r  
intr

F  
mic  
Maj  
of t

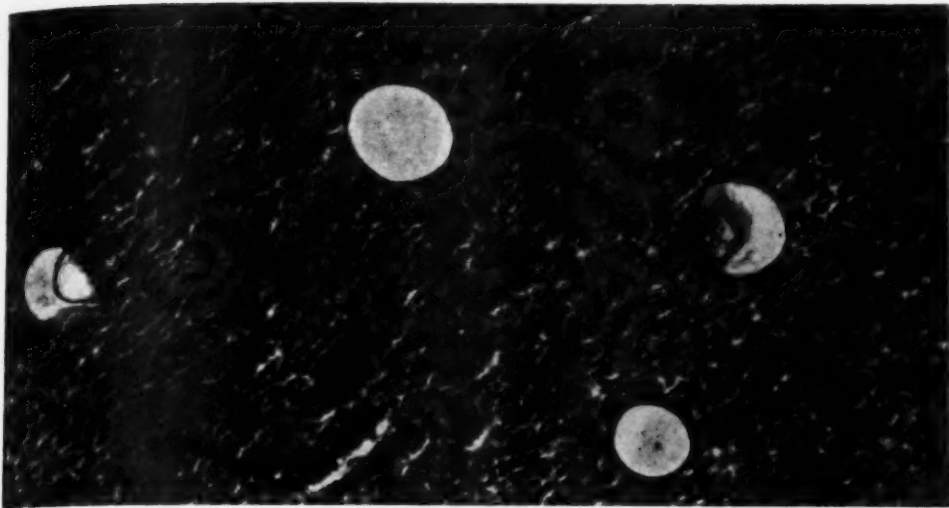


Fig. 2 (Anderson and Byrnes). Cysts in various stages of development. Compare with figure 4 reproduced from Kirkpatrick (plate 8). U. S. Army Medical Museum negative number 68470.

terial. These large cysts were almost all lined by an irregular layer of epithelium derived from the conjunctival epithelium, and some contained degenerate leukocytes in their granular contents. Almost all the parasitic cysts are more or less distorted and degenerate.

Almost all the parasitic cysts were more or less distorted and degenerate.

The treatment in our case consisted of simple excision. This was done in February, 1938, and to date there has been no recurrence. Excision is the method recommended by the Indian authors. In general there is said to be a strong tendency toward recurrence, particularly when the growth has not been excised with sufficiently wide margin, and when the polyp has been crushed in the manipulation incident to its removal. The treatment of multiple growths is said to be very unsatisfactory. Allen and Dave recommend excision, application of electric cautery, and the injection of 2 to 4 grams of neostiboson (Bayer) in 0.3-gm. doses intravenously.

Figures 1, 2, 3, and 4, of plate 8 are microphotographs taken from a report by Major Kirkpatrick, professor of pathology of the Medical College of Madras. They

are inserted for comparison with our microphotographs (figs. 4, 3, 2, 1) which are approximately identical magnifications. The titles of Professor Kirkpatrick's illustrations are self-explanatory.

Figure 4 in our series is a large cyst with highly refractile wall filled with spore morulae of varying size.

Figure 2 shows cysts of varying stages of maturity. Our figure 2 is to be com-

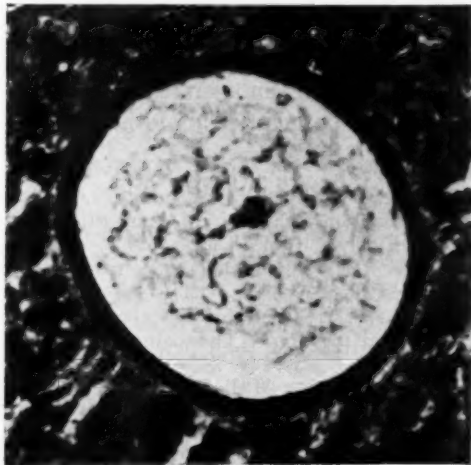


Fig. 3. (Anderson and Byrnes). Showing contents of cyst. U. S. Army Medical Museum negative number 68472.

pared with figure 4 (plate 8) of Dr. Kirkpatrick's series.

Figure 1 of our series shows a relative scarcity of cysts in contrast to those

with the *Rhinosporidium* reported in India. Cases of nasal polypi due to this condition have been reported in this country. So far as we can determine, no such



Fig. 4 (Anderson and Byrnes). Cyst with highly refractile wall containing spore morulae in varying stages of development ( $\times 750$ ). Compare with figures 1 and 2 reproduced from Kirkpatrick (plate 8).

reported in Professor Kirkpatrick's series, figure 3 (plate 8).

*Comment.* Almost by accident we have discovered a polyp of the conjunctiva which we have demonstrated to be due to a fungus. We believe this to be identical

infection of the ocular tissue has occurred. It is hoped that a search will be stimulated for further cases, and that by culture our impression of the identity of the organism will be confirmed.

#### BIBLIOGRAPHY

- <sup>1</sup> Ashworth. On *Rhinosporidium seeberi* (Wernicke, 1903) with special references to its sporulation and affinities. Transactions Royal Soc. Edinburgh, v. 53, p. 301.
- <sup>2</sup> Duke-Elder. Vol. II, page 1659.
- <sup>3</sup> McKee. In Berens's "The eye and its diseases." Philadelphia and London, W. B. Saunders Co., 1936, p. 413.
- <sup>4</sup> Kirkpatrick. Cited by Elliot and Ingram (see below).
- <sup>5</sup> Elliot and Ingram. Ophthalmoscope, 1912, v. 10, p. 428.
- <sup>6</sup> Tirumurti. Cited by Allen and Dave. Indian Medical Gazette, 1936, v. 71, July, p. 376.
- <sup>7</sup> Wright. Indian Medical Gazette, 1922, v. 57, p. 1922.
- <sup>8</sup> Duggan. Brit. Jour. Ophth., 1928, v. 12, p. 526.
- <sup>9</sup> Kurup. Proc. All India Ophth. Soc., 1931, v. 2, p. 104.
- <sup>10</sup> Rao, N. and V. Proc. All India Ophth. Soc., 1931, v. 2, p. 109.
- <sup>11</sup> Kaye. Brit. Jour. Ophth., 1938, v. 22, p. 445.
- <sup>12</sup> Caldwell and Roberts. Jour. Amer. Med. Assoc., 1938, v. 110, pp. 1641-1644.
- <sup>13</sup> Allen and Dave. Indian Medical Gazette, 1936, v. 71, p. 376.

## RHINOSPORIDIOSIS

### A CASE REPORT

EDWARD W. GRIFFEY, M.D.

*Houston, Texas*

E. K., a normally developed white boy, aged 10 years, presented himself on December 14, 1938, with a small strawberry-colored mass attached to the caruncle of the right eye. The child lives on a farm and helps take care of horses and cows. There are several children in the family but no others are affected.

The mass was nodular and solid, encapsulated, roughly pear-shaped, 12 by 10 by 6 mm. in size, and was attached to the upper edge of the caruncle and scleral conjunctiva by a thin stalk 5 to 8 mm. long. The mass was lying partly in the palpebral fissure so that the lids could not be completely closed at the inner canthus.

The mass was excised at the base of the pedicle; one suture was required to close the wound. The patient was last seen on January 14, 1939, and showed no sign of recurrence.

The specimen was sent to the Army Medical Museum where it was examined and diagnosed under Accession No. 60735 by Dr. Elbert De Coursey, who returned the following report:

*Gross:* The specimen was a white dome-shaped mass 9 by 8 by 4 mm. which at the peak showed a dark cyst 1 mm. in diameter. The surface was opaque and granular, the granules being opaque and slightly cream colored. On section the surface presented tiny indistinct granules. Opaque areas and a few reddish-brown dots were seen deep in the grayish-white, somewhat translucent ground work.

*Microscopic:* The mass presents a chronic inflammatory reaction around spores that are numerous in the subepithelial stroma and that are also present in

the surface epithelium. The spores are so numerous that several low-power fields show as many as 40 encapsulated organisms that vary in size from about 30 to 200 microns in diameter. With hematoxylin-eosin staining, most of the organisms show a thick amphophilic capsule surrounding a foamy granular material whose center contains an ovumlike structure with a distinct limiting membrane, a pseudogranular protoplasm, and a slight eccentrically placed rounded basophilic body about one third the diameter of the ovumlike structure. The larger organisms contain hundreds of blue-stained endospores filling the entire interior. The capsules of the large, mature organisms are thicker and somewhat refractile. The capsules stain blue with the Masson stain, and with Giemsa stain they stain red except in the largest ones, which stain blue. Within and around a recently ruptured organism there are infiltrating leucocytes. Each escaping endospore would seem to begin a new cycle of enlargement with multiple endospore formation.

The chronic inflammatory tissue is characterized by diffuse edema and an exudate composed chiefly of plasma cells mixed with lymphocytes, polymorphonuclear leucocytes and a few large mononuclears. Around the medium-sized and small encapsulated spores cellular reaction is not intensified, but since the cells are more numerous around groups of small forms it would seem that the rupture of mature organisms incites the cellular activity. The tissue is quite vascular. The vascular endothelium is not particularly swollen. The 1-mm., dark cyst appears over an ulcerated area and con-

tains one very large body filled with endospores, a recently ruptured body, and numerous free encapsulated endospores, some as small as 15 microns in diameter and some of which show on the surface. Infiltrating leucocytes and necrotic tissue are also present here. The squamous epithelium is greatly thinned out over much of the surface but in places it is thickened and infiltrated with leucocytes.\*

\* **EDITOR'S NOTE:** The reader is referred to the illustrations in the preceding article on the same subject by Anderson and Byrnes.

**Diagnosis:** Rhinosporidiosis, scleral conjunctiva.

**Comment:** In the seven reported (Caldwell and Roberts, Jour. Amer. Med. Assoc., 1938, v. 110, May 14, p. 1641) cases of this disease in North America all of the lesions have been in the nose. The Registry has two slides from a case that occurred early this year in North Carolina. The material in this instance is so well preserved and your history is of such interest that in addition to the rarity of the lesion we think that this case merits publication.

## THE EFFECT OF TARTAR EMETIC ON THE COURSE OF TRACHOMA\*

### SECOND REPORT

L. A. JULIANELLE, PH.D.  
*Saint Louis*

J. F. LANE, M.D.  
*Albuquerque, New Mexico*

AND

W. P. WHITTED, M.D.  
*Gallup, New Mexico*

In a preliminary communication<sup>1</sup> from this laboratory, a report was made on the experimental treatment of trachoma by intravenous administration of tartar emetic.\*\* While the data suggested that the drug might have a potential value in certain phases of this disease (for example, in corneal complications), it

was not possible at that time to define the extent of its usefulness. Since then, however, the occasion has presented itself to resume the study of this treatment both in white patients and in Indians on the Navaho reservation,† and it is now desirable to place the results on record.

\*From the Department of Ophthalmology, Washington University School of Medicine, and the U. S. Indian Service. This work was conducted under a grant (to L. A. J.) from the Commonwealth Fund of New York.

\*\*Since the preceding report, a supplementary communication on the use of tartar emetic in trachoma has been published by Derkač, V., Klin. Monatsbl. Augenheilk., 1938, v. 101, p. 418. It has also come to our attention that this drug was perhaps first used in trachoma by J. Louwerier, Geneesk. Tijdschr. Nederl.-Indie, 1923, v. 3, p. 63.

†The opportunity for conducting this study was made possible by the efforts of Drs. J. G. Townsend, W. W. Peter, and Polk Richards, of the U. S. Indian Service. In addition, we acknowledge gratefully the cooperation of Dr. Paul Vietzke of the Indian Service Hospital at Fort Defiance, Arizona, Dr. Leo Schnur of the Hospital at Fort Wingate, New Mexico, Mother Berchmans and Sister De Ricci of St. Michael's School in Arizona for extending the facilities and privileges of their respective institutions, and to nurses G. Engelman, M. Alexander, and R. Moldenhauer of the Indian Service.

## METHODS OF STUDY

The patients under observation in this study have been 22 in number, 18 of whom were treated on the Navaho reservation, while 4 came to the Washington University Medical Clinics. In 6 of the 18 Indian patients the disease was limited almost entirely to the lids, the reaction occurring in the cornea being only slight and insufficient to cause significant if any visual disturbance. These individuals were selected intentionally in order to determine the effect of tartar emetic on the conjunctival manifestations, since it was suspected from the previous study that disease of the lids did not respond to this treatment. The remaining 12 patients were in the advanced stages of the disease, which was characterized by marked involvement of the cornea with serious visual impairment, while the lids were predominantly thickened and scarred, with little or no clinical activity. The patients treated at the University Clinic were also of the advanced type. It will therefore be convenient to discuss later the effect of the treatment representative of the two groups (that is, trachoma, essentially of the lids or of the cornea).

Except for irrigations of saline and boric-acid mixtures in the morning, the treatment consisted almost entirely of injections of tartar emetic. As will be brought out later, atropine was used when indicated in the case of corneal ulcers. While the schedule of injections was necessarily varied, depending upon different conditions, the following proved to be satisfactory: 1 ampoule‡ (5 c.c. or 0.05 gm.) daily for the first six days; 2 ampoules three times a week for two weeks; 2 ampoules a week for two more weeks.

‡ Tartar emetic is obtained from various commercial houses, as sterile, 1-percent solution in ampoules of 5 c.c.

In following the progress of the treatment, both clinical observations and visual acuity were recorded on each patient once a week. It was intended to study the effect on the epithelial-cell inclusions, but, as it happened, in only one patient were these bodies found originally in sufficient numbers to make such a study significant. A careful check was kept of any toxic symptoms referable to the tartar emetic.

## RESULTS OF THE TREATMENT

*Effect on the Conjunctival Disease.* As already stated, six patients, all Navahos, were selected to determine the effect of tartar emetic on trachoma of the lid. As will be seen in table 1, the disease was characterized by only a minor degree of corneal involvement, and the visual acuity in each was within normal variations, indicating in another way the comparative freedom of the cornea from disease. These patients were under treatment over a period of 23 to 28 days, and they received from 61 c.c. (0.61 gm.) to 88 c.c. (0.88 gm.) of the drug. There is no necessity for elaborating upon the results observed in this group. A study of the accompanying table indicates clearly enough that the treatment had little effect on the trachoma of these patients. The conjunctival and corneal lesions remained approximately the same, and visual acuity, being as good as it was in the beginning, could hardly be expected to improve. The evidence suggests, therefore, that in early trachoma complicated by slight corneal participation, tartar emetic has little, if any ameliorative effect on the conjunctival disease. The most that can be said for the treatment in this case is that the symptoms did not progress in the interim. It seems, therefore, that for this variety of trachoma, other methods of therapy are indicated.

TABLE 1

EFFECT OF TARTAR EMETIC ON ESSENTIALLY CONJUNCTIVAL TRACHOMA

Patient	Dosage	Toxic Symptoms	Effect of Drug on			
			Vision		Lids	Corneae
			R	L		
T <sub>1</sub>	86 c.c. (.86 gm.)	Cough	20/30 20/20	20/20 20/20	Papillary with scarring. No change.	Slight pannus. No change.
T <sub>2</sub>	88 c.c. (.88 gm.)	Cough	20/20 20/20	20/20 20/50	Follicular and papillary. No change.	Slight pannus. No change.
T <sub>3</sub>	61 c.c. (.61 gm.)	None	20/40 20/20	20/20 20/20	Almost complete scarring. No change.	Slight pannus. No change.
T <sub>4</sub>	61 c.c. (.61 gm.)	None	20/40	20/20	Follicular and papillary with some scarring.	Slight pannus.
			20/20	20/20	No change.	No change.
T <sub>13</sub>	68 c.c. (.68 gm.)	None	20/30 20/30	20/70 20/70	Slight papillary activity all lids. No change.	Slight pannus. No change.
T <sub>14</sub>	73 c.c. (.73 gm.)	Cough	20/20 20/20	20/20 20/20	Papillary hypertrophy. No change.	Slight pannus. No change.

The double notations under effects of the drug represent the conditions observed before and after treatment.

R indicates right, and L left eye.

*Effect on the Corneal Disease.* The individuals selected for this part of the study were all patients with long-standing disease. For convenience, the data associated with them have been tabulated and brought together in table 2.

Analysis of the information reveals that the disease in the lids was markedly advanced, scarring being present in varying degrees, even to the point of completion, where the lids were greatly thickened, assuming the more or less cardboardlike appearance characteristic of this stage. Clinical activity was absent in the majority of the patients, and where infection was active it was only moderate or slight.

The corneal disease, on the other hand, was disproportionately exaggerated; in 9 patients (T<sub>7</sub>, 9 to 11, 15, 18, 20 to 22) scarring had already occurred; pannus was heavy and generalized in all; and in 3 (T<sub>20</sub>, 21, 22) active ulcers were present at the beginning of treatment. Examination of visual acuity before treatment demon-

strated differing degrees of impairment, restricted to counting of fingers in 1 (T<sub>19</sub>), light perception only in 2 (T<sub>15</sub>, 20), and even total blindness in 2 (T<sub>8</sub>, 11). In every instance, however, loss of vision was obviously a predominant characteristic of this group. There can be no doubt, therefore, that corneal involvement in this series of patients was extensive to a stage where its control is usually considered difficult.

The treatment varied in the different patients from 24 to 36 days, and the quantity of drug administered from 63 c.c. (0.63 gm.) to 170 c.c. (1.7 gm.). Unfortunately, tartar emetic proved to be abnormally toxic in the Indians, as will be brought out later, so that treatment was curtailed either by cessation or by reduction of the scheduled dosages. In spite of this curtailment, however, it will be seen from the data in table 2 that among the Navahos tartar emetic effected varying degrees of improvement in all the patients treated.

TABLE 2

EFFECT OF TARTAR EMETIC ON ESSENTIALLY CORNEAL TRACHOMA

Pa- tient	Dosage	Toxic Symp- toms	Effect of Drug on			
			Vision		Lids	Corneae
			R	L		
T <sub>1</sub>	106 c.c. (1.06 gm.)	None	20/200 20/70	6/200 20/70	Heavy scarring; very little activity. No change.	Heavy, general pannus; marked clouding. Pannus marked improve- ment; corneae clear and vessels smaller.
T <sub>2</sub>	68 c.c. (.68 gm.)	Muscular stiffness calves & thighs	15/100 20/65	15/100 20/50	Slight hyperemia, marked scarring. No change.	Slight pannus, moderate clouding. Pannus improved, corneae clear.
T <sub>7</sub>	102 c.c. (1.02 gm.)	None	5/200 Light percep.	2/200 12/200	Lids scarred; no activ- ity. No change.	Protrusion rt. corneae; both clouded with marked general pannus and scarring. Improvement both cor- neae.
T <sub>8</sub>	63 c.c. (.63 gm.)	Cough & vomiting	Blind Light percep.	20/20 20/30	Lids arrested. No change.	Marked general pannus R, moderate pannus L. R, definite improvement; L, barely visible pannus and complete clearing.
T <sub>9</sub>	108 c.c. (1.08 gm.)	None	4/200 20/100	20/70 20/65	Slight if any activity. No change.	Clouding with scarring both corneae; heavy general pannus. Both corneae much clearer, vessels still present.
T <sub>10</sub>	80 c.c. (.8 gm.)	Cough	9/200 20/60	9/200 20/70	Scarring with consider- able activity. No change.	Marked clouding, marked general pannus, with scarring. Definite improvement both eyes, but not arrested.
T <sub>11</sub>	87 c.c. (.87 gm.)	Cough	9/200 20/125	Blind Blind	Little if any activity. No change.	Marked clouding, marked general pannus with scarring, R. Corneae clearer, vessels still marked.
T <sub>12</sub>	98 c.c. (.98 gm.)	None	7/200 20/200	7/200 20/90	Entropion both upper lids; scarring with no activity. No change.	Marked clouding, marked general pannus. Marked improvement R, slight improvement L.
T <sub>15</sub>	90 c.c. (.9 gm.)	Cough	Light percep- tion 7/200	Light percep- tion 12/200	Entropion both lower lids and R upper; hy- pertrophied adhe- sions & scar tissue, no activity. No change.	Heavy clouding, heavy generalized pannus with scarring. Corneae clear, but vessels about the same.
T <sub>16</sub>	101 c.c. (1.01 gm.)	None	20/200 14/200	20/200 20/150	Marked scarring inter- persed with small areas of activity. No change.	Heavy pannus R and L with clouded corneae. Corneae clear, vessels thinner and fewer in number.

TABLE 2 (Continued)  
 EFFECT OF TARTAR EMETIC ON ESSENTIALLY CORNEAL TRACHOMA

Pa- tient	Dosage	Toxic Symp- toms	Effect of Drug on			
			Vision		Lids	Corneae
			R	L		
T <sub>17</sub>	Left hospital before treatments progressed far enough.					
T <sub>18</sub>	95 c.c. (.95 gm.)	None	20/50	20/200	Complete scarring; no activity.	R, slight pannus, clear corneae with old scarring; L, heavy generalized pannus, heavy clouding with scarring. R, improvement; L, cornea clear, many vessels absorbed, but some still remain.
			20/30	20/70	No change.	
W. U. Clinic:						
T <sub>19</sub>	160 c.c. (1.6 gm.)	Muscular stiffness, arm vessels thrombosed	C.F. at 2 ft. 6/20-1	C.F. at 3 ft. 6/20	Marked papillary hypertrophy. No change.	Heavy generalized pannus, marked clouding. Clear corneae with partial absorption of pannus; disease arrested.
T <sub>20</sub>	90 c.c. (.9 gm.)	Muscular stiffness and pain	Light percep.	6/20	Scarring & thickening; little activity.	L, suggestive, old pannus, inactive pterygium; R, general clouding, heavy general pannus, ulcer. Asymptomatic.
			C.F. at 1 ft.	6/20-1	No change.	
T <sub>21</sub>	90 c.c. (.9 gm.)	None	2/60	4/60	Scarring, moderate activity.	Clouding, heavy generalized pannus, scarring, with ulcer R. Asymptomatic.
			6/20	6/30	Asymptomatic.	
T <sub>22</sub>	120 c.c. (1.2 gm.)	Joint pains	6/10	Light percep.	Excessive purulent discharge, marked injection, papillary hypertrophy.	R, negative; L, opaque, heavy generalized pannus, ulcer, scarring.
			6/30-1	6/7.5	Asymptomatic.	

The double notations under effects of the drug represent the conditions observed before and after treatment.

R indicates right, and L left, eye; C.F. = counts fingers.

As might be anticipated, both because of the foregoing observations and because the amount of conjunctival activity was slight, if present at all, there was no noteworthy change in the lids following the course of treatment. Concerning the corneal disease: 1 patient (T<sub>17</sub>) had to leave the hospital, before sufficient treatment was given, because of epileptic seizures; 6 patients (T<sub>5</sub>, 8, 10 to 22) became asymptomatic following administration of tartar emetic; 2 patients (T<sub>6</sub>, 10) were definitely improved but the dis-

ease was not arrested; and in 7 (T<sub>7</sub>, 9, 11, 12, 15, 16, 18), improvement was especially marked, but it was difficult to state whether the infection was actually arrested. In the 3 patients with active ulcers (T<sub>20</sub>, 21, 22), healing was effected with the aid of atropine. In this connection it should be pointed out that patient T<sub>6</sub> (a syphilitic with possibly luetic iritis) developed two corneal ulcers during observation. Treatment was continued as usual and atropine was applied locally. There was complete healing of

the ulcers within 10 days under these conditions. There was marked clearing of the corneas to complete transparency in the different patients, with more or less resorption of capillaries, although the larger vessels were still discernible in each case. Scarring of the cornea was not affected.

Concurrently with corneal improvement there was a gain in visual acuity; in some patients this was particularly marked (see T<sub>5</sub>, 6, 10, 15, 19), in the others not so marked but very definite. It is interesting to note that the greater restorations of vision occurred in the patients either without or with minor corneal scarring. It should be obvious, of course, that where loss in vision is due to permanent histological change of the cornea, acuity remains deficient to that extent. It is felt that this observation on vision indicates better than any other way the amelioration observed in all the corneal examples of trachoma, since it alone provides a method for measuring objectively the effect of the treatment.

#### TOXIC REACTION ASCRIBABLE TO THE TREATMENT

In the former report<sup>1</sup> it was stated that of the various toxic reactions described as due to tartar emetic the only manifestation observed while treating patients with trachoma was stiffness of the muscles, particularly those in the regions of the lower leg and the back between the scapulae. While cough and even vomiting are described in textbooks as additional toxic symptoms, these were never observed in the white patients treated in Missouri, in Kentucky, and in the University Clinic. A careful study has been made of the toxic reactions appearing in the present groups of patients, and these are given in tables 1 and 2.

Analyzing the data, it will be seen that of the 22 patients studied, 10 completed treatment without clinical evidence of

toxic reactions ascribable to tartar emetic. Of the remaining 12, 7 (all Indians) were afflicted with paroxysms of violent coughing. § This came on within a few minutes after the injection, it lasted from 10 to 20 minutes and was alarming, when first encountered, to both patient and attendant. After the paroxysm had once subsided, there appeared to be no further disturbance, nor any aftereffect. In one of the individuals the coughing was complicated by vomiting. As a result of this reaction it became necessary to reduce appreciably, or even eliminate, subsequent injections. Three other patients suffered muscular stiffness and pain, one of whom ended the course of treatment with the arm vessels used for injections distinctly thrombosed. The last patient complained of articular pains which necessitated from then on a reduction in the amount of tartar emetic administered.

It is seen, therefore, that more than half the patients tolerated the drug with different degrees of disturbance and discomfort. Despite the toxicity, however, it remained possible to continue treatment in most patients by either decreasing the dosage or spacing the injections farther apart.

#### DISCUSSION

The present communication records the resumption of experiments on the treatment of trachoma with tartar emetic. In order to appraise the data fairly, it is necessary to consider the disease as, on the one hand, essentially, a conjunctival, and, on the other hand, essentially a corneal process. On the basis of this classification, it appears that tartar emetic is ineffectual in eradicating the conjunctival disease. This is in agreement with

§ In a personal communication, Dr. Dwight H. Trowbridge, of Fresno, California, reported a similar experience among white patients at one of his clinics.

previous studies, when it was suggested that in heavy conjunctival trachoma the drug be used as a supplementary procedure to grattage. In fact it was pointed out at that time that the most striking results with tartar emetic were observed when injections were given following this operation. The procedure adopted was one ampoule (.05 gm.) a day for four days including the day of operation and finally two ampoules on the fifth day. In cases of advanced corneal disease, this method of treatment causes definite improvement in most cases, even to rendering the condition asymptomatic. This improvement is determinable by recovery of vision as well as by diminution or disappearance of the clinical signs and symptoms. Why tartar emetic should act with a measure of success in this stage of trachoma and not in the conjunctival phase cannot be answered from the data available.

The toxicity of tartar emetic appears to have been greater in the present than in the previous study. Whether Navaho Indians are more idiosyncratic to the drug, or whether the current patients formed a more representative group is not clear. In any case, it does not seem necessary to forego further treatment because of the possible toxic reactions to the drug. Toxicity may be controlled by reducing the dosages, spreading injections over longer intervals, and introducing the drug very slowly.

If the evidence from the combined studies on tartar emetic can be interpreted correctly, it would follow that the drug may be used with benefit as a medication supplementary to grattage, and in advanced, scarred cases of trachoma with extensive corneal complications, especially those refractory to the

older methods of therapy. It seems wiser, therefore, to utilize tartar emetic only in these instances, rather than attempt to employ it for any and every patient with trachoma.

#### CONCLUSIONS

1. Tartar emetic used as described in the treatment of trachoma has little effect when the disease is essentially conjunctival.

2. When, however, conjunctival hyperplasia is sufficiently extensive to warrant grattage, tartar emetic administered according to the short schedule is a helpful, supplementary procedure.

3. Measured by clinical improvement and gain in visual acuity, the drug has a definite, beneficial effect on corneal trachoma, even rendering the disease asymptomatic.

4. In more than half the patients observed in this study, tartar emetic was patently toxic, inducing coughing, muscular stiffness and soreness, and in one case articular pain, in another vomiting, and in still another thrombosed veins.

#### ADDENDUM

Since the time of writing, five additional patients were treated with tartar emetic on the Navaho reservation. All manifested extensive corneal trachoma, and are to be classified with the second group reported above. They received from 110 c.c. (1.1 gm.) to 170 c.c. (1.7 gm.) of the drug. In three patients no toxic reactions were observed, while in one there was slight coughing, and in the other the cough was accompanied by muscular stiffness and pain. All the patients were definitely improved following the course of treatment, both the clinical condition and gain in visual acuity testifying to the improvement.

#### REFERENCE

- <sup>1</sup> Julianelle, L. A., Sory R., Smith, J. E., and Lange, A. C. Amer. Jour. Ophth., 1938, v. 21, p. 651.

## NOTES, CASES, INSTRUMENTS

### KRUKENBERG SPINDLES IN A PATIENT WITH INTERSTITIAL KERATITIS\*

MORRIS H. PINCUS, M.D.  
*Brooklyn, New York*

The nature of and the causative factors that enter into the formation of the Krukenberg's spindle have been a subject of divergent views since Krukenberg<sup>1</sup> first described this phenomenon. Some observers believe that it is congenital in origin; others claim that it is an acquired condition that usually follows intraocular inflammations.

Krukenberg spindles have never been observed in an individual during the first decade of life and only one case<sup>2</sup> has thus far been reported in the second decade of life.

This condition has been observed associated with various diseases of the eye, but it has also been found in otherwise apparently normal eyes. No case has been reported in which the Krukenberg spindles had been observed in the course of or following an attack of interstitial keratitis. The case which I am presenting is of interest in that it occurred in an individual who apparently had been subject to many exacerbations of interstitial keratitis and, although she had been a subject of numerous previous examinations, its existence had not been mentioned until her last admission to the clinic.

*Case Report.* I. DeC., a white woman, aged 26 years, of Italian extraction, came to the ophthalmological clinic of the Long Island College Hospital on May 28, 1938, complaining that she had headaches

when reading or sewing. Glasses were of no help to her. She stated that her discomfort was always felt in the left supra-orbital region and that it subsided after periods of rest. There was no history of nausea or vomiting. Her past history revealed that at the age of three years, she was taken to an eye hospital, where her mother was told that the child had "badly inflamed eyes." At the age of nine years, glasses were prescribed. She has worn glasses ever since. She had pneumonia at 17. She is married and has three children, all of whom are living and well. There were no miscarriages nor stillbirths. Her present complaint dates back two months. Six weeks ago, she went to an ophthalmological hospital seeking relief from these headaches. There, she had a blood Wassermann test. It was reported as two plus. After three anti-syphilitic injections, the blood Wassermann reaction became negative.

The physical examination revealed a well-nourished white female with chronically infected and hypertrophied tonsils. Her heart and lungs were normal. The blood pressure was 120/80. The urine was normal. Her blood Wassermann was negative. The otolaryngoscopic division recommended tonsillectomy.

Both upper lids were slightly ptosed. The lid actions appeared slightly impaired on upward gaze. The cornea of the right eye had a central nebulous opacity and the cornea of the left eye a more dense opacity. Both were vascularized. The anterior chambers were normal in depth. The pupils appeared to react to light, direct and consensual. The media were hazy, due to the corneal opacity in each eye.

The disc in the right eye was seen, but

\*From the Department of Ophthalmology, Long Island College Hospital.

appeared indistinct due to the corneal opacity. There was a small temporal myopic conus. The macula was not seen, nor could accurate details of the remainder of the fundus be discerned. It was the impression that nothing more than thinning of the retina existed peripherally.

The fundus of the left eye, due to the corneal opacity, was more obscured. It was the impression that no pathological change existed.

The extraocular muscle movements were normal.

Refraction estimated under cycloplegia with homatropine was: O.D. -4.00 D. sph., vision = 6/21; O.S. -3.00 D. sph.,  $\approx$  -2.00 D. cyl. ax. 180°, vision = 6/21.

The slitlamp examination of the left eye revealed a dense interstitial infiltration of the cornea. There were superficial as well as deep blood vessels throughout the cornea. Circulation of the blood cells was visible in the more superficially placed vessels. A superficial dull brown line extended obliquely from about the 8-o'clock position, to the middle of the cornea. On the endothelial surface of the cornea, by reflected light, there could be seen a longitudinal fusiform dustlike brownish pigment deposit opposite the pupillary opening. It was about 1 mm. wide and 4 mm. long. It was rather sharply demarcated, but a few of the same dustlike particles were scattered about on either side. The anterior chamber was normal in depth. No aqueous flare was present. The iris was brown in color, but, scattered throughout the crypts, were the same fine brownish particles that were noted on the endothelial surface of the cornea.

The slitlamp examination of the right eye showed that the cornea was less densely infiltrated and that the major portion of the interstitial infiltration oc-

cupied the central area of the cornea. The superficial and deeper blood vessels were distributed in a manner similar to that in the left eye. In the region of Bowman's membrane, a fairly heavy linear brown line extended across the cornea but was lost in the opacity of the central portion of the cornea. On the endothelial surface of the cornea, arranged in a vertical fusiform manner, was a deposit of fine brown pigmented particles. Its widest portion was about 1½ mm., opposite the pupillary opening, and it was about 5 mm. in length. On either side of it, scattered pigment particles were seen. The anterior chamber was normal in depth. No aqueous flare was present. The color of the iris was brown. Scattered over the crypts were the same pigmented particles.

*Comment.* It is of interest to note that this condition occurs more frequently in the female and is often associated with myopia. It does not seem to affect its possessors subjectively, inasmuch as the presence of the spindle does not affect vision. Neither individuals with hypermetropic refractive errors nor those with emmetropic eyes are immune. Krukenberg spindles have been found associated with these refractive errors.

The patient here described has been a frequent subject of observation for the ophthalmologist. Since her early childhood she has suffered from an eye affliction; and yet no note was ever made of the presence of these peculiar spindle pigmentations. When she came to the clinic, she was suffering from the after-effects of an interstitial keratitis which in her case may or may not be related to syphilis. Her blood Wassermann reaction was reported as two plus only once, and with only three intravenous treatments has since become negative serologically.

This case resembles in some degree the one mentioned by Friedenwald<sup>2</sup> who ob-

served the formation of the spindles in a patient with syphilitic uveitis, and who saw them disappear when adequate treatment resolved the process. In the latter respect this case differs from his. The evidence in this case points to the conclusion that the Krukenberg spindles were formed in the inflammatory process to

which the cornea was subjected. This instance may add a little weight in the scale, on the side of those who believe that Krukenberg spindles are not congenital in origin but rather the product of some infection or some disturbance occurring in the eye.

881 Washington Avenue.

## REFERENCES

- <sup>1</sup>Krukenberg. Beiderseitige angeborene Melanose der Hornhaut. *Klin. M. f. Augenh.*, 1899, v. 37, p. 254.  
<sup>2</sup>Zentmayer, W. Association of an annular band of pigment on the posterior capsule of lens with a Krukenberg spindle. *Arch. of Ophth.*, 1938, v. 20, July, p. 52.

TRANSIENT MYOPIA FROM  
SULFANILAMIDE

WATSON W. GAILEY, M.D.  
 Bloomington, Illinois

Mrs. H., white, female, aged 34 years, was referred by Dr. O. H. Ball for an ophthalmological examination on December 19, 1938. Two days previously, the patient had consulted Dr. Ball for a condition that he had diagnosed as a mild streptococcus infection of the throat. He had prescribed sulfanilamide 7 gr. to be taken with an equal amount of bicarbonate of soda, *q.i.d.* After taking 21 gr. on the first day, the patient awakened the next morning to find that her distance vision was extremely blurred. By noon of that same day it was difficult for her to recognize members of her own family at a distance of 10 to 15 ft. It was possible, however, for her to read newspaper type without difficulty. In addition to this symptom, she experienced nausea and some slight degree of cyanosis.

Ophthalmological examination on December 19, 1938, revealed vision of 15/200 in the right eye and 20/200 in the left. With a -3.25 D. sph. before the right eye she could read 20/20 and with

a -3.00 D. sph. before the left eye she could read 20/20. Her pupils were of normal size and reacted readily to light and accommodation. The tension in each eye was 34 mm. with a McLean tonometer. The visual fields were normal in area with no enlargement of the blind spot and no evidences of scotomata. Examination of the fundi was negative. The urine was negative and the blood sugar was 105 mg. per 100 c.c. A differential blood count was not made.

On the morning of December 20, 1938, examination revealed that a -2.50 D. sph. before each eye gave normal vision. On the following day her vision was normal in each eye without the aid of lenses and she was able to read Jaeger 1 at 14 inches with ease.

Subsequent examinations on December 28, 1938, and January 11, 1939, revealed no findings of any significance. Her vision remained normal and no changes were found in the retinae, not even the slightest evidence of edema. It was assumed that this had been an artificial myopia induced by an edema of the crystalline lenses.

The literature has been scanned for the purpose of finding a similar case and in only one instance was a report encoun-

tered that seemed to parallel this one, a case report published in the Illinois State Medical Journal, issue of April, 1939, by Dr. M. S. Spellberg of Chicago, in which Dr. A. H. Herman attributed a transient myopia to edema of the retina.

Subsequent examinations at 8 weeks and 12 weeks were made. Refraction under homatropine and paredrine was performed. The fundi were normal and the refraction was emmetropic.

### PARINAUD'S OCULOGLANDULAR SYNDROME\*

#### REPORT OF THREE CASES

FRANCIS H. MCGOVERN, M.D.  
*Danville, Virginia*

This syndrome, first described by Parinaud in 1889, is characterized by a unilateral conjunctival lesion with an associated regional adenopathy. Unfamiliarity of this syndrome by physicians other than ophthalmologists has led to mistaken diagnosis, especially in cases with submaxillary, preauricular, or cervical lymphadenitis—little attention being paid to the palpebral pathology. Last year I had occasion to see two cases of this syndrome within a week, and recently a third case, in which the diagnosis of the adenopathy varied from mumps to lymphosarcoma.

The syndrome is uncommon but not at all rare. Most authorities now agree that a number of etiological factors are involved; that there is no single cause. The combination of a conjunctival lesion with regional adenopathy is found in oculoglandular tularemia, tuberculosis of the conjunctiva, conjunctival syphilis, the leptothrix conjunctivitis of Verhoeff,\*\*

\* Read before the Virginia Society of Ophthalmology and Otolaryngology, at Roanoke, Virginia, May 6, 1939.

\*\* Verhoeff, F. H., and King, M. J. Arch. of Ophth., 1933, v. 9, Dec., pp. 701-714.

and several other less common conditions of debatable etiology. On occasion, because of insufficient knowledge or faulty technique, or in spite of most careful bacteriological and serological examination, a causative organism cannot or is not identified.

Certain of the acute purulent and inclusion lid and conjunctival diseases are associated with regional adenopathy, but the lymphadenitis is transient, inconstant, and of minor importance. In the cases here reported the adenopathy was of paramount interest, the primary ocular lesion receiving little attention. It is surprising how a somewhat insignificant conjunctival lesion can cause such massive enlargement of the cervical lymph nodes. The glandular swelling and the ocular symptoms are usually synchronous. The constitutional symptoms vary from severe, as in oculoglandular tularemia, to slight or absent, as in leptothrix conjunctivitis or tuberculosis of the conjunctiva. The appearance of the conjunctival lesion may suggest the causative organism, but some laboratory procedure is always necessary to verify the diagnosis.

#### CASE REPORTS

The first case is represented by a young physician who suddenly became sick with fever and malaise and tender enlargement of the right submaxillary and cervical lymph nodes. I first saw him 20 days after the onset. He gave a history of having performed an autopsy, six days before his illness began, on a pig suspected of being poisoned. He consulted several physicians; the diagnosis varied from mumps to lymphosarcoma. Little attention was paid to the palpebral swelling on the right side. He was very much concerned about the correct diagnosis and prognosis.

He was admitted to the Memorial Hospital on May 3, 1938. The upper lid of the

right eye was red and swollen; the upper palpebral conjunctiva presented a small raised yellowish plaque superficially ulcerated. The globe was entirely normal. The right submaxillary and preauricular lymph nodes were quite swollen and tender to palpation. Physical examination was otherwise negative. The temperature on admission was 101.8°F. and remained between normal and 100 degrees until the evacuation of a submaxillary abscess 10 days later. The white blood cell count was elevated to 13,000 with a preponderance of polymorphonuclear leucocytes and from one to four percent eosinophiles. The routine agglutinations for typhoid, tularemia, and undulant fever were negative on two occasions. Nothing was found on conjunctival smear and culture. Culture of the pus from the submaxillary abscess showed *Staphylococcus albus*. A guinea pig was inoculated subconjunctivally and intraperitoneally with material from conjunctival scrapings and pus from the abscess, with no apparent result. An autopsy of the guinea pig a month later showed no pathology. The culture technique described by Wright\* produced no growth of the leptothrix.

The clinical course and clinical appearance corresponded closely to Parinaud's conjunctivitis of animal origin. In spite of fairly complete examination, no etiological agent could be identified. Due to circumstances we did not excise conjunctival tissue and use the special staining methods of Verhoeff to demonstrate the leptothrix. The culture and isolation of this organism are apparently quite difficult. However, the rather severe constitutional reaction and the appearance of the conjunctival lesion did not coincide with the description of leptothrix conjunctivitis. When the prognosis was given the

patient was relieved and convalescence proceeded to complete recovery.

The second case was that of a young colored boy, aged 12 years. He presented a red swollen upper lid on the left side, with a nontender enlargement of the submaxillary lymph nodes on the same side. Palpation of the upper lid showed the swelling to be due to two separate nontender masses, resembling chalazia in many ways. No ulceration nor erosion was seen, although a previous observer had noted a superficial ulceration along the margin of the middle of the upper lid. The adenopathy was not tender nor red; it was grouped in more or less distinct masses. No constitutional symptoms were present. The tuberculin test was two plus. Blood taken for the routine agglutinations was reported negative. The blood Wassermann test was positive. The mother's Wassermann reaction was negative. A biopsy of a cervical lymph node was reported as follows: chronic hyperplastic lymphadenitis. There was no histological evidence of tularemia nor of tuberculosis. The pathologist believed that this involvement could possibly have a syphilitic background.

Under active anti-syphilitic treatment the nodules in the upper lid and the adenopathy disappeared somewhat slowly but completely by the end of two months. The Wassermann reaction was still four plus at the end of eight months of treatment. There were no stigmata of congenital syphilis.

The third case was that of a colored child, aged three years, referred to me because of an obstinate blepharitis and conjunctivitis of a month's duration. Examination showed a moderate amount of redness and congestion of the palpebral conjunctiva. The lid margins were red, swollen, and thickened. A small nodule was present near the lid margin of each lid at the external canthus. A large mass

\* Wright, R. E. Arch. of Ophth., 1937, v. 18, Aug., pp. 233-236.

was located at the angle of the jaw on the side involved. This adenopathy was not tender, about the size of a lemon plus several nodes. The Wassermann test was negative. The tuberculin test was four plus. The child's chest X ray was reported as showing no evidence of primary tuberculosis. Biopsy of a cervical node showed well-formed anatomical tubercles scattered through the lymphoid stroma.

At the present time the conjunctival nodules have disappeared, the lid swelling is very much reduced, and the adenopathy somewhat smaller. The absence of tuberculosis elsewhere in the body suggests this case as the rare manifestation of primary exogenous tuberculosis of the conjunctiva.

#### CONCLUSION

Three cases illustrating the oculo-glandular syndrome of Parinaud are reported; one caused by tuberculosis, the second by syphilis, and the third by some undetermined agent.

#### A NEW INSTRUMENT FOR KERATOPLASTY\*

ALBERT L. TAI, M.D.  
*Shanghai, China*

The purpose of this new instrument is to simplify and modify the present technique of keratoplasty. It is a corneal punch, the upper blade of which is a ring, 4 to 6 mm. in diameter, having a very sharp cutting edge beveled inward (fig. 1, A). The lower blade is solid and has a spherical surface (fig. 1, B) corresponding to that of the cornea; its cut-

\*From the Department of Ophthalmology, Shanghai Sanitarium and Hospital. This is an abstract of a paper originally published in Chinese, in the National Medical Journal of China (1938, v. 24, November), republished herein with the illustrations at the request of the author because of the limited circulation of this journal among American ophthalmologists.



Fig. 1 (Tai). Corneal punch for keratoplasty. A, upper blade with sharp beveling-edged cutting blade; B, lower blade with solid spherical surface, whose cutting edge (C) is slightly raised.

ting edge should be slightly raised (fig. 1, C) in order to facilitate cutting (fig. 2). Any undue pressure upon the corneal flap, especially on the endothelium, should be carefully avoided, for injury to the endothelium invariably results in opacity.

The technique of the surgical procedure using this corneal punch is simple (fig. 3), as follows: (1) A conjunctival flap is prepared and an incision is made along the upper limbus, either with a keratome or with the von Graefe knife, as for cataract extraction. (2) The corneal punch is used to remove the leucoma and to make the graft. (3) The graft is covered with the conjunctival flap using either Castroviejo's method or Stallard's.

The new instrument is being manufac-

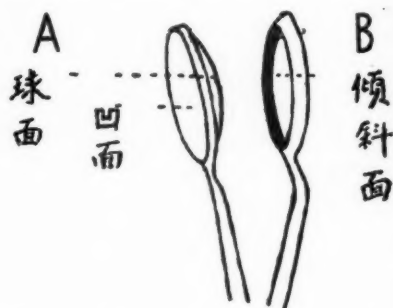
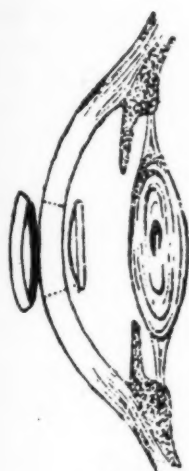
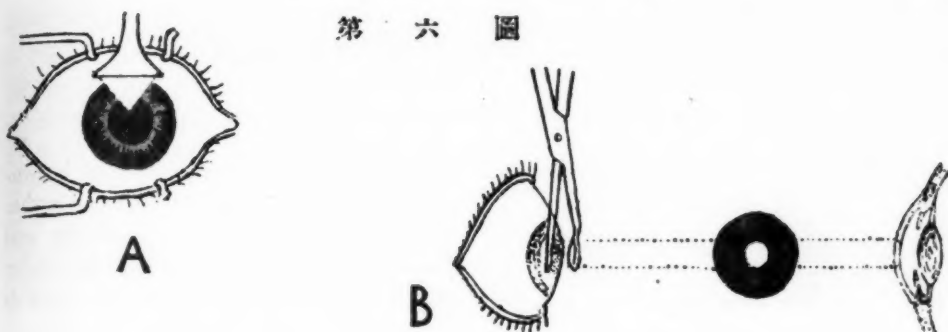


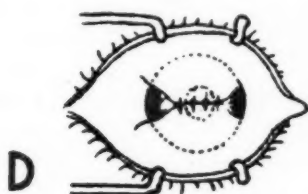
Fig. 2 (Tai). Diagrammatic sketch of corneal punch. A, spherical surface, concave side; B, beveling-edged ring blade.

## 第 六 圖



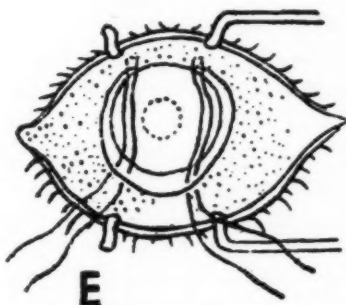
C

横剖面



D

## 第 七 圖



E

Fig. 3 (Tai). Surgical procedure. A, first step, keratome incision. B, second step, removal of leucoma, also cutting of graft. C, cross-section of second step. D, Castroviejo's method for completing operation. E, Stallard's method.

tured by the V. Mueller Instrument Company of Chicago. Some refinement will probably prove necessary, for the blade

is now perhaps a little too heavy and clumsy.

526 Bubbling Well Road.

# SOCIETY PROCEEDINGS

Edited by DR. H. ROMMEL HILDRETH

## COLLEGE OF PHYSICIANS OF PHILADELPHIA

### SECTION ON OPHTHALMOLOGY

December 15, 1938

DR. ALEXANDER G. FEWELL, *chairman*

#### IRIDESCENT CRYSTALS IN THE CRYSTALLINE LENS

DR. ALEXANDER G. FEWELL and DR. STIRLING S. MCNAIR said they had reviewed the literature with special reference to cases in which the crystalline lens contained iridescent crystals. Ordinary crystals in the lens are not uncommonly found, but iridescent crystals in the lens are indeed infrequent. Most of the cases of iridescent crystals in the lens reported showed the crystals to contain some calcium salt, protein, or one of the amine acids. In their search through the literature, they were able to find only one case, reported by Beresinskaja, that by chemical analysis was proved to contain cholesterin crystals. In a majority of the cases reported the iridescent crystals were found bilaterally. Although these crystals are supposedly due to degenerative changes in a cataract, the majority of the cases reported stated that the remaining portion of the lens was clear. It is surprising how few lenses containing iridescent crystals have been extracted and examined chemically.

The case reported is that of a colored woman, 69 years of age, with bilateral anterior polar cataracts along with senile cataracts. She had had diabetes for the past four years and also suffered with hypertension. The vision O.D. was 3/60 and O.S. 2/60. Examination with the

slitlamp revealed large masses of brownish-golden glistening crystals somewhat tightly packed together in places and more dense and numerous in the center and on the temporal side. These crystals were mostly in the center of the lens and the remainder of the lens was relatively clear. The fundus was seen with difficulty on account of these crystals and lens opacities. The disc was somewhat dusky, arteries were reduced in caliber, and some retinal changes were seen in the macula, but no hemorrhages. The left eye showed a mature cataract but no crystals. The fundus of this eye could not be seen. The presenters expect to extract the lens of the right eye and subject its crystals to microchemical examination the results of which they hope to report at a later date.

*Discussion.* Dr. Alfred Cowan said the case which he reported before this Society three or four months ago was different from this one. In his case the crystals were very brightly colored, red, green, yellow, orange, and were more or less densely arranged in a zone in and around the adult nucleus. Actually, it was a case of presenile, zonular cataract that had undergone degeneration. He would consider the case here tonight an atypical complicated cataract.

Dr. William Zentmayer stated that some years ago, Dr. Verhoeff reported a case of coralliform cataract. A thorough analysis of the crystals forming the opacity showed them to be protein. Soon after this report, he removed a lens with the same type of cataract, and sent it to Dr. Verhoeff. The analysis showed the same type of crystals as was found in his own case.

## OCULAR PEMPHIGUS

DR. JOSEPH V. KLAUDER and DR. VAN M. ELLIS reported the case of R. H., a white man, aged 21 years, who is unable to state exactly when the present condition started. He had had ocular trouble at the age of four years, at which age he was said to have had a growth on the right eye. The cornea of the right eye is clear. There is adhesion of the conjunctiva of the lower lid to the bulbar conjunctiva, obliterating the cul-de-sac. The upper cul-de-sac is narrowed but there is no symblepharon. The left cornea also is clear, and there is no involvement of the conjunctiva. The cul-de-sacs are, however, narrowed. The vision is unimpaired. There is no involvement of the mucous membranes of the nose, mouth, throat, urethra, or anus. There has never been any cutaneous involvement.

*Discussion.* Dr. H. Maxwell Langdon believed the condition did not look like pemphigus. He had never seen pemphigus limited to the lower cul-de-sac and had never seen it last so long without the other eye becoming involved. He thought it rather a possible scarring from the inflammation of 17 years ago.

Dr. Klauder, in conclusion, said they were glad to know Dr. Langdon's opinion. They are inclined to regard the condition as progressive. It appears to be more pronounced now than at the time they first saw the patient. In formulating their opinion of ocular pemphigus in this patient they were not entirely influenced by symblepharon, but placed considerable significance on the dry, lusterless, wrinkled appearance of the bulbar conjunctiva external to the cornea and above the symblepharon. Its appearance is that of shriveling, which is a conspicuous symptom eventually seen in all patients with ocular pemphigus.

## OLD INTERSTITIAL KERATITIS

DR. JOSEPH V. KLAUDER and DR. VAN M. ELLIS presented the case of a white man, aged 58 years. He had always had poor eyesight and had worn glasses for many years. He remembered having sore eyes when a child but could not recall any details. He denied ever having a genital lesion. Following a blood test 10 years previously, he received injections in the arm at intervals for three months.

The pupils were unequal and irregular in outline; that of the right eye was fixed to light; the pupil of the left eye reacted slightly to light. Gross inspection of the corneas showed faint opacities. The vision with correction was: right eye 6/15, left eye 6/30. The central portion of the cornea was gray with a moderate loss of smoothness. The posterior surface was thickened, fairly opaque, and contained a number of old blood vessels deeply situated. Examination of the left eye was essentially the same. The patellar reflexes were absent and the Romberg sign was positive. He presented no stigmata of congenital syphilis excepting possibly the facies of congenital syphilis and had no subjective symptoms of tabes. The Wassermann reaction of the blood was four plus, the Meinicke reaction two plus. The spinal-fluid examination was negative in all phases.

The patient was presented to call attention to the importance of being conscious of the cornea in examining patients of any age suspected or known to have syphilis. This applies more to the clinician and syphilologist than to the ophthalmologist who is more cognizant of the significance of old corneal opacity as a clue in the diagnosis of old interstitial keratitis than is any other group of physicians.

Corneal examination, especially slit-lamp microscopy, may be an important

procedure in examination of a patient, especially an adult with a positive Wassermann reaction. These examinations may be the only means of determining that the patient has congenital syphilis.

LUPUS ERYTHEMATOSUS WITH EXUDATIVE RETINITIS EFFECTIVELY TREATED WITH GOLD

DR. JOSEPH V. KLAUDER and DR. VAN M. ELLIS said that E. D., a white man, aged 36 years, was first examined in April, 1938, at which time he exhibited on each side of the face and on the forehead bright red areas ranging in size from a dime to a half dollar. Some were infiltrated, all were devoid of scales. The scalp and mucous membranes were not involved. Ophthalmoscopic examination revealed various-sized, irregular, fluffy, cloudlike patches scattered throughout the fundi, particularly around the disc. There were small fresh hemorrhages around the maculae. Vision was 3/60 in each eye. Three months prior to this the patient had chills, fever, general malaise, weakness, and tiredness which necessitated bed rest. About that time he developed an eruption on the face. A month later he noticed blurring of vision. He was incapacitated from January, 1938, until about April because of progressive weakness and loss of 23 pounds in weight. There was no history of tuberculosis; he had always been underweight but of good general health. The Mantoux test, 1-100, was negative, Roentgenograms of the lungs were negative as was examination of the sputum for tubercle bacilli. The urinalysis and blood Wassermann reaction were negative. The blood sugar was 71.7; urea 13.6; uric acid 3.1. A complete blood count on March 26, 1938, showed red blood cells 4,640,000; white blood cells, 3,400; polymorphonuclears, 46 percent; eosinophiles, 1 percent; lymphocytes, 45 percent; mono-

cytes, 8 percent. On April 1st the white blood cells numbered 6,200 and on April 4th, 8,300. Histologic examination showed subacute diffuse dermatitis and atrophy of the epiderm with local hyperplasia.

Since April, 1938, he has been treated with gold and sodium thiosulphate intravenously (the maximum dose 50 mg.) and bismuth salicylate 2.5 c.c. intramuscularly. These drugs were given in courses at weekly intervals. Apparently this treatment has been effective. The skin lesions disappeared, he gained 15 pounds in weight, and is no longer tired. The appearance of the fundi improved. The retinitis is now quiescent. The optic disc has a pale white tint; it is well outlined. Some of the larger vessels have been replaced by scar tissue, other vessels are sclerosed and have a corkscrew appearance. The vision of both eyes is 6/60.

*Discussion.* Dr. Walter I. Lillie said the fundi reveal a diffuse perivascularitis and periphlebitis associated with pallor of the discs, and new blood-vessel formation around and involving each disc. Although a retinitis specific for lupus erythematosus has never been described, the retinitis observed before the sodium-gold-thiosulphate therapy was instituted could be of a toxic origin.

The present fundal change is similar to that which occurs after intravenous quinine therapy in a person with an idiosyncrasy to quinine.

In his experience, sodium gold thiosulphate has produced no untoward ocular effects and has been quite efficacious in cases of posterior uveitis.

THE PRODUCTION OF CORNEAL ULCERS IN THE RABBIT

DR. ROBB McDONALD and DR. HORACE PETTIT stated that a fairly standard staphylococcus ulcer suitable for experi-

mental purposes can be obtained providing one uses rabbits of approximately the same size and weight and sensitizes them with a vaccine of the same strain that is used to produce the ulcer. When one uses a nonhemolytic nonpigment-forming strain of staphylococcus, one can obtain an ulcer that has a minimum amount of conjunctival reaction but will show infiltration and staining of the cornea for approximately 10 to 12 days. When both eyes are injected at the same time, there is marked uniformity in the appearance and course of each ulcer. They suggest that this procedure be carried out when one eye can be treated and the other used as a control. They feel that the corneal reaction may be a very delicate test for specific antibodies and contemplate further investigation of the problem.

#### THE SURGICAL INDICATIONS IN PTOSIS

DR. EDMUND B. SPAETH read a paper on this subject.

Warren S. Reese,  
Clerk.

### MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

#### SECTION ON OPHTHALMOLOGY

December 9, 1938

DR. FRANK N. KNAPP, *president*

#### THE VALUE OF TESTING DUCTIONS IN ROUTINE REFRACTION

DR. WALTER H. FINK, Minneapolis, presented a paper on this subject.

#### EXPERIMENTAL STUDIES OF VARIOUS WOUND CLOSURES USED IN CATARACT EXTRACTION, WITH CLINICAL APPLICATION

DR. ANDERSON HILDING, Duluth, presented a report which consisted largely of

a motion-picture demonstration of experiments in iris prolapse made upon enucleated ox eyes. It also included a demonstration of the application in clinical surgery of the points learned. The experiments consisted essentially in the production of iris prolapse in four different surgical procedures under controlled conditions. The prolapse was produced by the injection of saline into the eyes under measured pressure which could be controlled at will.

Four different methods of dealing with the limbal incision, which are commonly used in cataract surgery, were tested. They were (1) simple limbal incision with no measures taken to reinforce it against gaping, (2) incision covered with various types of flap, (3) incision closed by means of a sclerocorneal suture, (4) same as number three with the addition of a peripheral iridotomy.

Some 400 prolapses were studied under controlled conditions. The results demonstrated (1) that all conjunctival flaps that were tried (with one exception) failed to reinforce the incision materially, (2) that sclerocorneal sutures held the lips of the incision so firmly together that very considerable pressures (from 100 to 160 mm. of mercury) could be withstood before iris prolapse occurred, (3) that a peripheral iridotomy placed in such a way that it would coincide with the incision offered further protection against prolapse, (4) that an iridotomy was useless unless it coincided with the point of the incision that gaped, and was useless if it failed to emit fluid. Forty-six patients have been operated on by this method and allowed out of bed on the second postoperative day. There has been no prolapse nor incarceration in any.

*Discussion.* Dr. Frank Burch, St. Paul, said they are interested and pleased with the presentation which Dr. Hilding had given of proving the mechanics of iris

prolapse. It seems very sound and logical. In cataract work, everyone is agreed as to the value of sutures. There are a good many tricks in sutures and most operators have their own fetishes and prejudices and favorite methods in dealing with cataract wounds. The weak spot, perhaps, in Dr. Hilding's operation is that the wound is not covered with conjunctiva. Personally he would rather have a conjunctival flap than a section not covered with conjunctiva. Some time ago he visited Dr. Castroviejo and was shown how he had modified his cataract operations by a technique he was developing. He makes his incision with conjunctival flap close to the limbus, then, using a special atraumatic needle with unusually fine silk (needle made by Davis and Geck), sutures all around the wound. He believes he has performed 90 such operations without a prolapse. He was very enthusiastic about it, came home and tried it, and immediately had a prolapse; nevertheless, the method appealed to him. It seems logical and perhaps with greater practice he may be able to make conjunctiva-covered sections with sutures very close to the limbus and avoid prolapses.

The method they have used very extensively the last few years, which he borrowed from Dr. Gifford, is to make a Van Lint covered flap, first placing a mattress suture in the cornea just below the limbus. The conjunctiva is dissected free for a short distance around the proposed incision, the latter being made entirely within the cornea. A double-armed suture is passed through the conjunctiva above, drawing the conjunctiva over the wound. This makes a very tight wound, and he cannot recall any instance in which they have used it that prolapse has occurred.

Dr. Hilding's presentation is a very excellent way to approach the subject. He cannot quite agree with him about the

simple peripheral iridotomy as sufficient to permit fluid to come through from the posterior to the anterior chamber. A single peripheral iridectomy is preferable and serves the purpose. Of value also is the use of pilocarpine just before the section is made in case one is preserving a round pupil and then, after the sutures are placed, the injection of an air bubble into the anterior chamber. Following this, one-half percent eserine alkaloid bichloride ointment is put into the conjunctival sac. One of his associates, Dr. Hoffman, has insisted that both pilocarpine and eserine should be used to prevent iris prolapse, after completion of the operation. He believes there is some logic in using both miotics because of their slightly different manner of promoting miosis.

Dr. Charles N. Spratt, Minneapolis, said that Dr. Hilding has demonstrated what every surgeon knows and what every ophthalmologist should know, that healing takes place more quickly in a sutured wound, and there is less danger of prolapse or loss of cavity contents, whether the wound be of the abdominal cavity, the brain, or the eye. The use of the suture dates back to 1867 when Williams of Boston suggested a scleral conjunctival suture. While he was a house officer in Boston and New York, he never saw a cataract wound sutured. For the past 15 years he had been using a pocket flap with a conjunctival suture and he is sorry to state that he has had prolapse in some cases because he did not use good judgment in making an iridectomy, especially in elderly patients with rigid irides. These prolapses were protected by the conjunctiva and were thus free from danger of secondary infection. The use of the buttonhole, described by Chandler in 1890, or a small iridectomy would have avoided the prolapse. He believes that there is no question but that the corneoscleral suture makes a tighter

wound than the conjunctival suture. As the pressure of an eye is rarely over 25 mm. it seems unnecessary to consider pressure as high as 150 to 160 as shown in Dr. Hilding's demonstration.

Dr. Charles Hymes, Minneapolis, said that Dr. Hilding's presentation had been very illuminating. Referring to the triple iridotomy, a single well-functioning iridotomy should carry out the same purpose as the triple iridotomy. For this reason, in a closed fluid cavity, the hydrostatic pressure is equal at all points within the space, and any increase of that pressure is exerted equally upon all points within.

It is common knowledge that men who do a small amount of eye surgery, as well as beginners, have a great deal of difficulty in the performance of an iridectomy. The reasons, of course, are largely psychological, owing to the fact that the eyeball is open and soft, and any false move is fraught with danger.

By the results of Dr. Hilding's experiments, the eyeball with or without conjunctival sutures, is able to withstand a pressure of 15 to 20 mm. of mercury. This is almost as much as the normal intraocular pressure. There is really no great object in having the eye capable of withstanding pressures of 100 mm. of mercury or more. With the eye at reasonable rest following cataract extraction, in the hands of a large majority of ophthalmic surgeons, prolapse of the iris will take place but rarely.

He is not opposed to the corneoscleral suture, but he does feel that for the average eye surgeon the more simple he can make his cataract operation the happier both he and his patient will be.

Dr. Anderson Hilding, in closing, said in this operation the wound is covered by conjunctiva. When the sutures were placed in the sclera, the needle came through the conjunctiva rather high up.

When tied the conjunctiva slides down over the incision.

The Van Lint, and other flaps mentioned, all have the same objection; namely, that the conjunctiva is too distensible to offer any considerable reinforcement to the incision.

As to a single iridotomy compared with three, a single iridotomy is sufficient only in case the breach in the incision occurs at a point opposite the iridotomy. If it occurs anywhere else the iridotomy is useless. The matter may be summed up in this way: If there is sufficient intact iris to cover completely a breach in the incision, then iris prolapse would be possible even in the presence of six iridotomies. When a full iridectomy has been made, prolapse of one column or the other may occur. This is common experience.

Dr. Burch spoke of leaving an air bubble in the anterior chamber. From the standpoint of mechanics of prolapse, this is a splendid idea. The bubble holds the iris away from the cornea.

He does not know how much pressure an operated-on eye can withstand but it should be able to withstand enough to prevent prolapse of the iris. Prolapse still continues to occur when conjunctival flaps are depended upon to reinforce the incision. He does not believe that it is the normal intraocular pressure that we must fear in connection with prolapse. It is the unusual sudden pressure of the patient's hands, or some slight accident, or the increased pressure incident to coughing, sneezing, and so on. We do not know how high these pressures go.

The criticism that this operation is more complicated and difficult than some others is fair. It is more difficult to perform. Efforts to simplify are under way now, and he believes that they will be successful.

George E. McGeary,  
Secretary.

LOS ANGELES SOCIETY OF  
OPHTHALMOLOGY AND  
OTOLARYNGOLOGY

December 19, 1938

DR. WILLIAM BOYCE, *chairman*

PRESENTATION OF CLINICAL EYE CASES  
FROM THE LOS ANGELES COUNTY GEN-  
ERAL HOSPITAL

DR. WARREN WILSON, Senior Resident  
in Ophthalmology (by invitation) pre-  
sented the following cases:

Four cases of interstitial keratitis in  
conjunction with congenital lues, which  
were treated by malaria therapy. All  
showed great improvement. Before treat-  
ment vision was reduced to the ability to  
count fingers at three feet, while after-  
ward one patient obtained 20/20 vision  
and the others better than 20/200.

A case of tubercular interstitial kera-  
titis which remained placid under long  
continued tubercular therapy; this patient  
had been treated for six years.

A Mexican woman, aged 43 years, with  
unilateral proptosis of four years' dura-  
tion, the etiology of which was unex-  
plained. Complete physical and neurologi-  
cal examination, sinus and cranium X-  
ray films all were negative. Her basal  
metabolic rate was minus 11. Vision was  
20/20 uncorrected. Possible soft tissue  
tumor behind the orbit seemed the most  
reasonable conclusion.

A case of osteogenesis imperfecta with  
associated blue sclera. This patient, 42  
years old, has had over 40 fractures. His  
father had the same condition with as-  
sociated otosclerosis. The patient has one  
normal sister and two sisters with oto-  
sclerosis and brittle bones, two normal  
brothers, and three brothers with brittle  
bones and blue sclera. One of the affected  
brothers has a son who also had brittle  
bones and blue sclera.

A 21 year-old girl with unilateral glau-

coma of over two years' duration. She had  
only light perception in the affected eye,  
a normal-sized cornea, very deep anterior  
chamber, and very deep cupping of the  
nerve head. This patient had two treph-  
ining operations, and on study with contact  
glass adhesions were seen in the iris angle  
only at the site of these two operations.  
However, since the second operation two  
months ago, the tension has remained  
normal.

A 45-year-old Negro, who is an albino,  
the only one in his family so affected so  
far as he knows. The patient had 20/70  
vision in each eye with correction in spite  
of marked nystagmus.

DR. DAVID MCCOY, Junior Resident in  
Ophthalmology (by invitation) presented  
the following cases:

Four cases of trachoma in one family,  
two girls, aged 8 and 13 years, and two  
boys, aged 10 and 14 years, respectively,  
who had received ambulatory treatment  
with sulfanilamide and who are now ap-  
parently cured, having had no further  
treatment for the past four months.

One woman of 29 years, who had had  
trachoma for 18 months, was treated with  
sulfanilamide and was now apparently  
cured. There was marked regression of  
pannus. She had had no treatment for the  
past four months.

A woman, aged 26 years, with phthisis  
bulbi in the left eye following an automo-  
bile accident in 1925, at which time she  
received a perforating injury. In this eye  
the lens was apparently dislocated under  
the conjunctiva above. There was some  
scleral ectasia. Six weeks ago she re-  
ceived a contusion of the right eye fol-  
lowed by marked bulging of the upper  
nasal quadrant of the sclera, probably due  
to rupture with prolapse of the ciliary  
body. The lens was not dislocated and the  
vision was 20/20.

Harold F. Whalman,  
*Editor.*

# AMERICAN JOURNAL OF OPHTHALMOLOGY

*Published Monthly by the Ophthalmic Publishing Company*

## EDITORIAL STAFF

LAWRENCE T. POST, *Editor*

640 S. Kingshighway, Saint Louis

WILLIAM H. CRISP, *Consulting Editor*

530 Metropolitan Building, Denver

EDWARD JACKSON, *Consulting Editor*

Republic Building, Denver

HANS BARKAN

Stanford University Hospital, San Francisco

WILLIAM L. BENEDICT

The Mayo Clinic, Rochester, Minnesota

GRADY E. CLAY

Medical Arts Building, Atlanta

HARRY S. GRADLE

58 East Washington Street, Chicago

H. ROMMEL HILDRETH

824 Metropolitan Building, Saint Louis

F. PARK LEWIS

454 Franklin Street, Buffalo

C. S. O'BRIEN

The State University of Iowa, College of  
Medicine, Iowa City

M. URIBE TRONCOSO

500 West End Avenue, New York

DERRICK VAIL

441 Vine Street, Cincinnati

F. E. WOODRUFF

824 Metropolitan Building, Saint Louis

EMMA S. BUSS, *Manuscript Editor*

6820 Delmar Boulevard, Saint Louis

*Directors:* LAWRENCE T. POST, President, WILLIAM L. BENEDICT, Vice-President, F. E. WOODRUFF, Secretary and Treasurer, EDWARD JACKSON, WILLIAM H. CRISP, HARRY S. GRADLE. *Address original papers,* other scientific communications including correspondence, also books for review and reports of society proceedings to *Dr. Lawrence T. Post, 640 S. Kingshighway, Saint Louis.*

Exchange copies of medical journals should be sent to *Dr. William H. Crisp, 530 Metropolitan Building, Denver.*

*Subscriptions,* applications for single copies, notices of change of address, and communications with reference to advertising should be addressed to the *Manager of Subscriptions and Advertising, 640 S. Kingshighway, Saint Louis.* Copy of advertisements must be sent to the manager by the fifteenth of the month preceding its appearance.

*Author's proofs* should be corrected and returned within forty-eight hours to the *Manuscript Editor.* Twenty-five reprints of each article will be supplied to the author without charge. Additional reprints may be obtained from the printer, the George Banta Publishing Company, 450-458 Alhainp Street, Menasha, Wisconsin, if ordered at the time proofs are returned. But reprints to contain colored plates must be ordered when the article is accepted.

## THE AMERICAN BOARD CELEBRATES

Available facts concerning the first definite movement toward the organization of the "American Board for Ophthalmic Examinations" (now the "American Board of Ophthalmology") have been admirably assembled and related by Beach (*Transactions American Ophthalmological Society, 1938, volume 36, page 175; also American Journal of Ophthalmology, 1939, volume 22, page 367*).

It has been suggested, not entirely in jest, but with only a modicum of truth, that the credit for creation and development of the American Board of Ophthalmology is due, not to the ophthalmologists, but to the so-called profession of optometry\*.

The claims made to professional status by a group of refracting opticians did, perhaps, tend to put the ophthalmologists of this country more completely on their mettle, and may have reënforced the warnings uttered by Jackson, Wilder, and others to the effect that many ophthalmologists needed to do more careful refraction work. But, in the words of John C. Weeks, optometric utterances were "only one of the stimuli that were instrumental in the creation of the examining Board, and not an important one."

The twenty-fifth anniversary of the

\*"Optometry," a word taken from the French language, signifies in the first place merely "measurement of vision." The use of the term "optometrist" to designate a refracting optician is about one generation old.

creation of the Board (1914-1939) was recently celebrated by a dinner held at the Palmer House, Chicago, in association with the annual meeting of the American Academy of Ophthalmology and Otolaryngology. Invitations had been sent out to all the Board's diplomates, now numbering something like 1,500; and the dinner was attended by 150 or more persons.

With Walter R. Parker, one of the early members of the Board, as toastmaster, addresses were delivered by Walter B. Lancaster, on "The Ophthalmic Board, looking backward and looking forward," and by Edward C. Ellett, one of the original members of the Board, on "Former members of the Board," this expression being applied to those who are no longer living, and including Albert E. Bulson, Alexander Duane, Lee M. Francis, James M. Patton, William Campbell Posey, J. Wendell Reber, Myles Standish, Frank C. Todd (first secretary of the Board), John M. Wheeler, William H. Wilder (secretary of the Board from 1918 to 1935), and Hiram Woods.

Lancaster, reviewing briefly some of the events dealt with more abundantly in Beach's historical survey, expressed the hope and belief that Beach would some day continue the story to include the Board's later activities. The speaker reminded his audience that the first recommendation favored by the reformers back in 1913 and 1914 was that Class-A medical schools should establish graduate courses in ophthalmology leading to a suitable degree. It will be remembered that the English universities at Oxford and Liverpool had already moved in this direction, and that Jackson had succeeded in establishing a similar course under the auspices of the University of Colorado.

When the American Board took definite form, the idea that it should confer a degree was taboo because the granting of degrees was a function of the universities. Licenses are obviously the business

of state governments, although the thought of using an examination as a basis for special licensure has been advanced and still finds supporters.

Lancaster recalled that the Board's "certificate, with its ophthalmoscope, fundus oculi, and serpent of Esculapius," had been designed by Casey A. Wood (who, we hope, is still enjoying his retirement at Rome, Italy).

When the Board's first examination was held at Memphis, in December, 1916, Jackson, against the urgent objections of the other Board members, insisted on sitting down with the candidates to take the written examination.

A year or so ago, when the Advisory Council of Medical Specialties, formed by the Council on Hospitals and Medical Education of the American Medical Association in conjunction with the various national examining boards, first formulated a standard of uniform requirements to be observed by all the boards, it became necessary to point out that facilities for institutional training of ophthalmologists were still inadequate, that (as Lancaster remarked) "two hundred men could not be squeezed into forty residencies, that less than twenty per year could be accepted by the few institutions with graduate courses on a university basis," so that "impractical though well-meant theory gave way before irresistible common sense and experience."

After the addresses by Lancaster and Ellett, the Board's chairman for the current year, Conrad Berens, presented to Jackson a framed illuminated address on parchment, carrying, above the names of all past and present members of the Board, a message of appreciation for the persistence and adroitness with which the recipient had led the original movement toward the creation of the Board.

We must recognize that some type of formal standardization and certification of special practice was a necessity and was

bound to develop. To ophthalmologists, however, it is naturally gratifying that their specialty should have pioneered in a movement which has now advanced to formation of twelve national examining boards, whose diplomates will shortly be listed in a directory to be published by the Advisory Council of the American Medical Association.

The present voluntary form of organization, conducted within the ranks of the medical profession, has distinct elements of superiority over earlier proposals for the establishing of licensing bodies in every state of the Union. It has stimulated material advance in facilities for special training, and is certain to promote even greater educational achievements in the years to come. The work of the pioneers commands our respect and admiration.

W. H. Crisp.

#### VITAMIN DEFICIENCIES IN OPHTHALMOLOGY

It has for many years been recognized that the usual errors of refraction are products of eyestrain, but no modern ophthalmologist is satisfied to confine his study of eyestrain to simple refraction. Other factors such as the general health, phorias, and aniseikonia must be considered.

The past week has witnessed an unprecedented influx of letters inquiring about aniseikonia. It would seem that hundreds of those suffering with asthenopia had read the recent article on aniseikonia in one of the popular magazines, because all of those who use the eikonometer have been deluged with requests for examinations. Undoubtedly inequality in the size of images is one of the many causes of eyestrain. How frequently it produces this effect is far from being determined. Another newly discovered cause is apparently vitamin-A deficiency, ac-

cording to an article by Cordes and Harrington in this issue of the Journal.

The importance of the vitamins in life has become increasingly apparent since their discovery a few years ago. This subject has taken hold of the public fancy almost equally with allergy, and if the cost were not prohibitive probably most of our patients would be consuming the little vitamin pills, many of them adding to an already adequate supply of vitamins. However, in this very interesting paper we have a group of people called to our attention who evidently are definitely deficient in at least one important element in metabolism; that is, if a low power of dark adaptation is a true index of it.

Why this avitaminosis should cause symptoms of eyestrain is not quite clear, except that it is now known that there is a measurable amount of vitamin A in the retina which obviously must have something to do with retinal functioning. If, therefore, vitamin A be deficient it is not unreasonable to suppose that an unusual effort of concentration might be necessary to produce a clear and intelligible visual interpretation. Apparently those who from any cause, whether dietetic or natural, have a deficiency of this vitamin are subject to visual inadequacy, as in the case of those whose eyes have been subjected to a bright light for a long time, and thus have used up this supply of vitamin A in the visual purple.

The simplest way to determine defective dark adaptation is with the Bio-Photometer, but this is an expensive instrument—not desired by everyone. It becomes important, therefore, to analyze the cases of asthenopia that have apparently derived from this cause with a view to determining whether anything in their histories or in the results of physical and ocular examinations would suggest such origin.

The authors have reported on 82 patients who suffered from persistent as-

thenopia in spite of refraction, and whose Bio-Photometer reactions were low. More than half were presbyopic, and two thirds were female. More than two thirds complained of sensitivity to light. A fairly typical group of symptoms is pointed out by the authors. The frequency of digestive disturbances and the absence of night blindness in most cases were interesting, the latter difficult to explain.

The results claimed for the therapy are truly remarkable in that four fifths of the patients had complete relief from symptoms. This is a striking report and is certain to attract much comment and to be given a full trial by many, so that before long confirmatory or contradictory reports should be available. May the event prove the case, for any therapy that will benefit these patients with persistent asthenopia will be most warmly welcomed.

Lawrence T. Post.

### BOOK NOTICES

**SURGERY OF THE EYE.** By Meyer Wiener, M.D. and Bennett Young Alvis, M.D. Clothbound, 445 pages, 396 illustrations. Philadelphia and London, W. B. Saunders Company, 1939. Price \$8.50.

This is one of the most interesting books on the subject of surgery that has been written in many years. It does not pretend to be a complete reference book but includes the most important operations on the eye and gives almost in narrative form the authors' personal experience with them. There are many ideas that are original with the authors and have been proved successful by extensive trials in their hands. Having had one of the largest surgical practices in this country, Dr. Wiener is especially qualified to have written this kind of book.

The reviewer has had the pleasure of serving for many years on the same staff as the authors and has had the opportunity of seeing them operate and hearing

them teach; hence he knows the fundamental soundness of the principles they have here laid down. Many of Dr. Wiener's techniques have become a part of the routine in the ophthalmic departmental surgery at Washington University, where he has taught for many years. These range from the simple but most useful method of threading a needle with silk to the complicated but effectual gold-plate advancement of an extraocular muscle.

Throughout the book are valuable little suggestions such as the rolling down of the conjunctival flap in trephining—a favorite operation of Dr. Wiener's—over a toothpick applicator, and the circumcision of the cornea with a canaliculus knife, in enucleations.

In these days when corneal transplants have become practical there is still a place for the authors' operation of excision of scar tissue by means of a crucial incision. The restoration of vision made possible by this means is astonishing to those who have never tried it.

Approximately the middle third of the book is devoted to plastic surgery. Dr. Wiener taught this subject during the World War and ever thereafter it was a favorite field. The subject is clearly and concisely handled and is well illustrated, as is the entire book, both in number of pictures—there being almost one to a page—and in their diagrammatic value.

Among other original procedures dealt with are the open method of performing the Mota's operation for correcting ptosis and the Wiener-Sauer dacryocystorhinostomy.

Most surgical texts are dry—serve only for reference. Here is a book that is readable and instructive, and one that will demand attention. Though naturally prejudiced, the reviewer is sure that to recommend this book highly to his confrères is doing it less than justice.

Lawrence T. Post.

# ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP  
ASSISTED BY DR. GEORGE A. FILMER

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is only mentioned in one. Not all of the headings will necessarily be found in any one issue of the Journal.

## CLASSIFICATION

- |  |  |
|--|--|
| 1. General methods of diagnosis                        | 10. Retina and vitreous                                |
| 2. Therapeutics and operations                         | 11. Optic nerve and toxic amblyopias                   |
| 3. Physiologic optics, refraction, and color vision    | 12. Visual tracts and centers                          |
| 4. Ocular movements                                    | 13. Eyeball and orbit                                  |
| 5. Conjunctiva   | 14. Eyelids and lacrimal apparatus                     |
| 6. Cornea and sclera                                   | 15. Tumors   |
| 7. Uveal tract, sympathetic disease, and aqueous humor | 16. Injuries   |
| 8. Glaucoma and ocular tension                         | 17. Systemic diseases and parasites                    |
| 9. Crystalline lens                                    | 18. Hygiene, sociology, education, and history         |
|  | 19. Anatomy, embryology, and comparative ophthalmology |

### 1

#### GENERAL METHODS OF DIAGNOSIS

Berezinskaja, D. I. **A reply to Dr. I. M. Machlin** (see below). *Viestnik Opht.*, 1939, v. 14, pt. 5, p. 68.

A defense of her technique in the investigation of the diffusion of acids and alkalies in the anterior chamber.

Ray K. Daily.

Machlin, I. M. **Comments on Berezinskaja's article "Diffusion of acids and alkalies into the anterior chamber."** *Viestnik Opht.*, 1939, v. 14, pt. 5, p. 67.

A criticism of Berezinskaja's technique and conclusions. (See *Amer. Jour. Opht.*, 1938, v. 21, p. 1402.)

Ray K. Daily.

Rocha, Hilton. **Roentgenograms in ophthalmology.** *Opthalmos* (Brazil), 1939, v. 1, no. 1, pp. 62-79.

With 19 illustrations, chiefly roentgenographic, the author considers especially the value of X-ray pictures in disturbances of the lacrimal passages

and as regards intraocular calcification. For the lacrimal cases, contrast was obtained with lipiodol and neo-iodipina. In two cases of chronic dacryocystitis, X-ray showed a bilocular condition of the sac. The intraocular cases include calcification of the choroid, of the lens, and of the retina. W. H. Crisp.

### 2

#### THERAPEUTICS AND OPERATIONS

Alvaro, M. E. **Snake venom in ophthalmology.** *Amer. Jour. Opht.*, 1939, v. 22, Oct., pp. 1130-1146; also *Trans. Amer. Acad. Opht. and Otolaryng.*, 1938, 43rd mtg., p. 304.

Braunstein, H. E. **Phototherapy in ophthalmology.** *Viestnik Opht.*, 1939, v. 14, pt. 5, p. 63.

Description of a Soviet-manufactured device for ultraviolet irradiation, using an argon-mercury globe. (Illustration.)

Ray K. Daily.

Carlevaro, G. F. **The action of vitamin B<sub>1</sub> in certain ocular affections**

(clinical and experimental research observations). *Ann. di Ottal.*, 1939, v. 67, May, p. 355.

The efficacy of vitamin B<sub>1</sub> in various nerve affections such as alcoholic neuritis, and in other forms of polyneuritis has been well established but the mechanism through which it acts has not yet been demonstrated. The author carried out a series of experiments with vitamin B<sub>1</sub> in certain ocular affections in which studies were made of that form of avitaminosis secondary to deficient assimilation. In simple dendritic herpes the effect of Betabion was exceptionally good. In one case of herpes ophthalmicus with iridocyclitis and paresis of the abducens the use of vitamin was without effect. In tobacco-alcohol toxic amblyopia the effect of Betaxin intravenously was remarkably beneficial. Not only was the sight improved but there was increase in weight with general betterment. In the experimental research with animals the nerves were traumatized and repair carefully observed. One group of these animals was given vitamin B<sub>1</sub>, while a control group received no treatment. The action was found to be largely on the myelin sheath. (Bibliography, 2 plates.)

Park Lewis.

Castroviejo, Ramon. **Mosquito lid-clamp retractors.** *Amer. Jour. Ophth.*, 1939, v. 22, Sept., pp. 1018-1019.

Erlanger, Gustav. **Iontophoretic medication in ophthalmology.** *Arch. Physical Therapy*, 1939, v. 20, Jan., p. 16.

Iontophoresis, the introduction of drugs into living tissues by weak galvanic currents, is shown to be often much more effective than methods of medication usually employed. Experiments on rabbit eyes demonstrate the

strong effect of certain drugs on the autonomic system. Clinical observations are quoted to point out the value of this form of treatment in diseases of all parts of the eye. (Graphs.)

George A. Filmer.

Hallay, L. I. **Oligoseptic treatment of ocular infection.** *Amer. Jour. Ophth.*, 1939, v. 22, Sept., pp. 1012-1014.

Horner, W. D. **Demonstration of a special solvent dispenser for removal of adhesive plaster.** *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1938, 89th mtg., p. 301. (See *Amer. Jour. Ophth.*, 1939, v. 22, May, p. 541.)

Malte, C. V. **A new anesthetic, di-caine.** *Viestnik Ophth.*, 1939, v. 14, pt. 6, p. 58.

The use of this preparation in the eye clinic and in 1,000 ophthalmic operations convinces the author that it is in no way inferior to cocaine.

Ray K. Daily.

Richman, F. **A new surgical needle and holder.** *Trans. Amer. Acad. Ophth. and Otolaryng.*, 1938, 43rd mtg., p. 400.

The needle is firmly anchored to the handle to form a single unit, but is readily detached and replaced. There are two eyes, one near the point for carrying the suture and another further back for guiding the suture, with a groove along the undersurface connecting the two. The several steps in the technique of suturing by this new method are described. (2 illustrations.)

George H. Stine.

Terry, T. L., Chisholm, J. F., Jr., and Schonberg, A. L. **Studies on surface-epithelium invasion of the anterior segment of the eye.** *Amer. Jour. Ophth.*, 1939, v. 22, Oct., pp. 1083-1108.

Valle, Sergio. **Snake anavenin in ophthalmology.** *Arquivos Brasileiros de Oft.*, 1938, v. 1, Dec., pp. 105-123.

The author relates briefly 14 cases in which this substance was injected subconjunctivally for the relief of ocular pain of greatly varied causation. He had begun by using the substance in ocular complications of leprosy. It acts as an analgesic. W. H. Crisp.

## 3

### PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Bari, Enzo di. **Tolerances in the centering of spectacle glasses.** *Boll. d'Ocul.*, 1938, v. 17, Dec., pp. 985-990.

On the basis of optico-physiologic considerations, the writer tabulates the tolerances of lenses up to plus and minus 20-D. lenses. M. Lombardo.

Berens, C. **A prism scale.** *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1938, 89th mtg., p. 302.

The author describes and illustrates a scale designed for the study of the amount of prism prescribed in glasses. (One illustration.) George H. Stine.

Bogoslovski, A. I. **The dependence of the contrast sensitivity of the eye upon adaptation.** *Ophthalmologica*, 1939, v. 97, July, p. 289.

For a low level of brightness of the test field (under one lux on white) regardless of its color, dark adaptation increases contrast sensitivity. When the field brightness is increased several lux on white, the differential threshold for red, blue, and white light in the daylight increases; in the dark it decreases. For green, it remains unchanged until the field brightness is increased to several hundred lux on white. The data for the other colors remain the same in this brighter light. F. Herbert Haessler.

Cowan, Alfred. **Hypermetropia.** *Amer. Jour. Ophth.*, 1939, v. 22, Sept., pp. 998-1002.

Fernandez Isassi, H. **Optical data one should not forget.** *Anales Soc. Mexicana de Oft. y Oto-Rino-Laring.*, 1938, v. 13, July-Dec., pp. 1-30.

Defines and describes many forms of single, bifocal, and tinted lenses, together with other details of daily refractive work. W. H. Crisp.

Georgariou, P. **Occupational dyschromatopsia and the Ishihara color tests.** *Bull. Soc. Hellénique d'Ophth.*, 1939, v. 8, Jan.-March, p. 59.

The author has found that the majority of persons showing defective color perception by the Ishihara charts appear to have perfect color vision when tested with colored wool or glass. George A. Filmer.

Glees, M. **A simple adaptometer.** *Klin. M. f. Augenh.*, 1939, v. 103, Aug., p. 226.

The instrument is described and illustrated. It is handy and portable, and may be placed in any dark room. Several persons may be examined simultaneously. The examiner does not need to be dark-adapted.

C. Zimmermann.

Granit, R., Munsterhjelm, A., and Zewi, M. **The relation between concentration of visual purple and retinal sensitivity to light during dark adaptation.** *Jour. of Physiology*, 1939, v. 96, June 14, pp. 31-44.

The authors find that the rise in sensitivity lags behind the increase in the concentration of visual purple, and they conclude that the rise in sensitivity, as measured electrically during dark adaptation, is not a simple func-

tion of the curve depicting visual-purple regeneration in terms of density values.

T. E. Sanders.

Halper, P. A. **Finer uses of the cross cylinder in refraction.** Illinois Med. Jour., 1939, v. 75, Feb., p. 115.

A review of some of the more common uses of the cross cylinder in refraction, particularly with a view to the interpretation of findings from an optical standpoint. Its value in determining the presence and axis of small astigmatic errors not accurately measured by retinoscopy is particularly noted. (Illustrations, discussion.)

George A. Filmer.

Hecht, S., and Mintz, E. V. **The visibility of single lines at various illuminations and the retinal basis of visual resolution.** Jour. Gen. Physiology, 1939, v. 22, May 20, p. 593.

The visual resolution of a single opaque line against an evenly illuminated background was studied over a large range of background brightness. It was found that the visual angle occupied by the thickness of the line when it was just resolved varied from about ten minutes at the lowest illumination to 0.5 second at the highest illumination, a range of 1200 to 1. This relation shows two sections, the data at low intensities representing rod vision, at high intensities, cone vision.

T. E. Sanders.

Jackson, Edward. **Theory and use of cross cylinders.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1938, 89th mtg., p. 21.

The history of the cross cylinder is reviewed, and the optical principles and clinical uses are described. (Discussion.)

George H. Stine.

Kalashnikov, V. P. **Stability of accommodation in infectious diseases.** Viestnik Opht., 1939, v. 14, pt. 6, p. 35.

The state of accommodation was determined ergographically. None of the infectious diseases showed a specific curve, the curves differing with the degree of intoxication of the accommodative apparatus and not with the type of infection. The study shows that disturbance in accommodation was caused by toxins and not by high temperature. In most infections, including diseases of the lungs, malaria, and typhus, normal accommodation was restored during the period of convalescence, but some cases of grippe and angina showed a persistence of accommodative instability beyond the period of convalescence. Reading during the subfebrile period of convalescence while lying down and in poor light is conducive to accommodative instability.

Ray K. Daily.

Kravkov, S. V. **The effect of caffeine on color sensitivity.** Viestnik Opht., 1939, v. 14, pt. 6, p. 61. (See Amer. Jour. Ophth., 1939, v. 22, Aug., p. 930.)

Livingston, P. C. **Analysis of the judgment of relative position.** (Preliminary communication.) Brit. Jour. Ophth., 1939, v. 23, Aug., pp. 540-544.

The author states that the object of his dissertation is to bring to notice certain features of binocular vision which in his opinion have not received full recognition, and which when studied carefully reveal close association with depth perception. Depth perception is said to be the highest stratum of spatial recognition. The use of rotating depth-perception apparatus, and of the rotating stereogram and pictures, is explained. (Illustrations.)

D. F. Harbridge.

Marquez, M. **Contribution to the study of the ophthalmoscopic size of the direct image.** Arch. d'Ophth. etc., 1939, v. 3, July, p. 580.

In this mathematic paper the author attempts to solve the problem of the size of the direct image. He believes that its diameter varies with the distance to which it is projected by the observer. This distance should correspond to the plane at which the inversed image is obtained by indirect ophthalmoscopy. (Diagrams.)

Derrick Vail.

Powell, L. S. **The practical use of homatropine-benzedrine cycloplegia.** Amer. Jour. Ophth., 1939, v. 22, Sept., pp. 956-959; also Trans. Amer. Acad. Ophth. and Otolaryng., 1938, 43rd mtg., p. 264.

Prado, Durval. **Skiascopy.** Arquivos Brasileiros de Oft., 1939, v. 2, Feb., pp. 1-5.

This is a brief statement with diagrams, of the application of optical principles to the practical technique.

Queiroga, Geraldo. **Biochemistry of vision, its practical value in the light of biophotometry.** Ophthalmos (Brazil), 1939, v. 1, no. 1, pp. 41-56.

From experiments on frogs, supplemented by consideration of the literature of the subject, the author indulges in some rather vague conjectures with regard to light adaptation and the influence of avitaminosis. (Drawings, graphs.)

W. H. Crisp.

Terrien, F., and Onfray, R. **Use and value of the diploscope in refraction.** Arch. d'Ophth. etc., 1939, v. 3, July, p. 577.

Rémy in 1901 described the diploscope which the authors believe has not

received the attention it merits. By means of this simple instrument one can determine the state of visual acuity, the comparative size of the images of the two eyes, the condition of binocular vision, the state of the oculo-muscular equilibrium, and indirectly the correspondence of accommodation and convergence.

Derrick Vail.

Tree, M. **A rotating cross cylinder.** Brit. Jour. Ophth., 1939, v. 23, Sept., pp. 632-633.

The author presents an illustration of his rotating cross-cylinder instrument together with a discussion of its advantages, as he believes, over the fixed type of Jackson's instrument. By the use of a cogwheel in the handle operated with the index finger, the axes of the cylinders are rotated instead of twirling the instrument as in the Jackson model. Jackson has always insisted that the twirling gives absolute suddenness to the change, thus producing a maximum contrast, but Tree believes his instrument to be less awkward.

D. F. Harbridge.

#### 4

#### OCULAR MOVEMENTS

Borsotti, Ippolito. **The importance of recognizing hyperfunction of the inferior oblique in the surgical treatment of paralysis of the superior oblique.** Rassegna Ital. d'Ottal., 1939, v. 8, March-April, pp. 123-178.

The author attempts to explain the divergence of opinion between American and European ophthalmologists as to the relative frequency and importance of paralysis of the superior oblique and that of the contralateral superior rectus. He reviews the physiology of the vertically acting muscles with especial regard to surgical treat-

ment of paralysis of the superior oblique. This is followed by a review and anatomic consideration of ten different surgical procedures for correction of the paralysis. The author feels that recession of the contralateral inferior rectus is the best method in most cases, as this establishes the static and dynamic equilibrium of the two eyes. It is stated that one may disregard the horizontal action of the vertically acting muscles, considering only the vertical and torsional components. Four cases are reported in detail in which myectomy of the inferior oblique was done with good results. The article is a valuable review of the physiology and surgery of the vertically acting muscles. (10 figures.)

Eugene M. Blake.

Krimsky, E. **Descriptive atlas of orthoptic slides.** Trans. Amer. Acad. Ophth. and Otolaryng., 1938, 43rd mtg., p. 404.

This atlas describes the author's slides and their use in a stereoscope. (References.) George H. Stine.

Kupreev, S. H. **Advancement with one suture.** Viestnik Opht., 1939, v. 14, pt. 5, p. 29.

The one suture holds the middle third of the muscle and conjunctiva in a double loop, and perforates the episclera at the limbus. A report of 26 cases shows that this operation corrects more deviation than does Meller's operation. (Illustrations.) Ray K. Daily.

Scala, N. P., and Spiegel, E. A. **The mechanism of optokinetic nystagmus.** Trans. Amer. Acad. Ophth. and Otolaryng., 1938., 43rd mtg., p. 277.

The authors studied the mechanism of the subcortical type of optokinetic nystagmus (passive) in cats and dogs, and found the production of this nystagmus depended on the integrity of

the superior colliculi. One-sided lesions of this structure impaired the nystagmus to the opposite side, while in bilateral lesions the most rudimentary reactions could be elicited by optokinetic impulses. These experiments suggest that the vestibular nuclei play an important part in the mechanism of passive nystagmus. (6 illustrations, tables, bibliography, discussion.)

George H. Stine.

Starkiewicz, Witold. **Oculomotor disturbances and their treatment.** Klinika Oczna, 1939, v. 17, pt. 3, p. 307.

An exhaustive review of the literature. Ray K. Daily.

Stein, Lester. **A polarizing screen for facilitating the cover test.** Amer. Jour. Ophth., 1939, v. 22, Oct., pp. 1147-1149.

Sternberg-Raab, Alice. **On double vision after squint operation.** Brit. Jour. Ophth., 1939, v. 23, Aug., pp. 568-573.

The subject is discussed by means of case presentations, all adults as the author did not have the opportunity of observing the manifestation in children. The situation is comparatively rare. The cases studied fall under two classes, one being caused by a still faulty position of the eyes, the other by abnormal correspondence. In the one instance the task is to develop fusion amplitude, while in the other binocular vision is to be induced. The degree of squint and of the eventual angle gamma are of greatest importance both before and after the operation. (References.) D. F. Harbridge.

## 5

### CONJUNCTIVA

Askalonova, T. M. **Streptocide in the therapy of blennorrhea in adults.** Viestnik Opht., 1939, v. 14, pt. 5, p. 55.

A report of a case responding well to the internal administration of this therapeutic agent (a preparation similar to prontosil).

Ray K. Daily.

Chang, S. P. **Clinical experiences with quinine treatment of trachoma.** Chinese Med. Jour., 1939, v. 55, May, pp. 439-447.

A series of 80 patients treated regularly two to three times a week for 2½ to 19 months with a 10-percent solution of quinine bisulphate is reported. The results were: completely cured 25 percent, almost cured 33.75 percent, considerably improved 30 percent, and no improvement 11.25 percent. On the average the effect of treatment became manifest in about two months, but usually at least six months was necessary for cure. A few patients were found to be resistant to quinine, but responded favorably to alternations of quinine with copper.

T. E. Sanders.

Charamis, J. **Conjunctivitis in molluscum contagiosum.** Bull. Soc. Helénique d'Opht., 1939, v. 8, Jan.-March, p. 40.

A small granulation on the lid margin of an eye which had been subacutely inflamed for five months proved on histologic examination to be molluscum contagiosum. The conjunctivitis cleared spontaneously following excision of the tissue.

George A. Filmer.

Cuénod, A., and Nataf, R. **Trachoma and the rickettsias.** Ophthalmologica, 1939, v. 97, July, p. 277.

A brief summary is given of recent morphologic and experimental studies of trachoma. From this summary the authors conclude that the infectious agent of trachoma has some characteristics of the rickettsia although it differs in other respects. They prefer the expression "rickettsioid body" to "tra-

choma rickettsia," and favor calling the trachoma virus "Prowazekia trachomatidis" in honorable acknowledgment of the work of Prowazek.

F. Herbert Haessler.

Cuénod, A., and Nataf, R. **Regarding the rickettsias of trachoma.** Arch. d'Opht. etc., 1939, v. 3, July, p. 592.

A reply to Foley and Parrot (Amer. Jour. Ophth., 1939, v. 22, p. 1183) as to whether the so-called rickettsias of trachoma are true rickettsias.

Ivanov, H. K. **Tuberculosis of the conjunctiva.** Viestnik Opht., 1939, v. 14, pt. 5, p. 24.

Three cases are reported in detail. The patients were all young women, and the disease was unilateral. One case was a primary conjunctival ulcer with enlargement of the retro-auricular lymphatic glands, and the result was recovery. In the second case, a metastatic conjunctivitis with a clinical picture of tuberculous nodules and follicles, the final cicatrization resulted in an entropion. The third case in the form of a tuberculoma, ending in atrophy of the globe, was caused by extension from the nose and mouth.

Ray K. Daily.

Kattiofsky, W. **Experiences as to the efficiency of sulphanilamide in gonorrheal eye affections.** Klin. M. f. Augenh., 1939, v. 103, Aug., p. 214.

The chemotherapy of gonorrheal eye diseases is enriched by the sulphanilamides. Alburid is especially valuable, as it is easily soluble in water and has no toxic effect.

C. Zimmermann.

Kulczycki, A., and Podworski, E. **Cytology of the trachomatous conjunctiva.** Klinika Oczna, 1939, v. 17, pt. 3, p. 419.

The material consisted of scrapings from the eyes of 35 children. The epi-

thelium of the trachomatous conjunctiva shows plasmonuclear changes; the products of karyokinetic division in the cells of the follicles are seen free or are contained in Leber's cells which act as macrophages. In all cases of untreated trachoma the smears made from the follicles show extra and intracellular bodies resembling Prowazek inclusion bodies and rickettsia. (Illustrations.)

Ray K. Daily.

Lapidus, I. M. **The treatment of trachoma with intravenous injections of 1-percent solution of antimony tartrate.** *Viestnik Opht.*, 1939, v. 14, pt. 5, p. 53.

The remedy was tried in thirty cases of severe trachoma with favorable results in five.

Ray K. Daily.

Loe, F. **Sulphanilamide treatment of trachoma; preliminary report.** *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1938, 89th mtg., p. 57.

The author treated 140 cases of trachoma with sulphanilamide, giving one-third grain per pound of body weight daily for ten days and then one-fourth grain per pound daily for fourteen days. Reactions were surprisingly few and mild. The results were remarkable with prompt recovery in all cases; however, it is too soon to speak of a permanent cure. Two cases are reported in detail. (Discussion.)

George H. Stine.

Maggiore, Luigi. **Application of the Credé method for the prophylaxis of purulent ophthalmia of the newborn in Italy.** *Ann. di Ottal.*, 1939, v. 67, June, p. 401.

Conditions were studied both from social and scientific aspects. Results have not invariably been considered satisfactory. The method of Credé has occasionally been followed by excessive irritation in the eyes of the newborn,

and in some instances disastrous results have followed its inexact application. This led the author to send a questionnaire to university clinicians, both ophthalmologists and obstetricians, as to their experience with the Credé method. All obstetric and other public hospitals are required to use a solution of 1-percent silver nitrate in the eyes of the child as directed. About one third of those answering the questionnaire preferred other silver salts to the nitrate. One regularly employed the acetate.

Park Lewis.

Makarov, H. H. **The data of the Chita Hospital on the use of diphtheria antitoxin in the treatment of gonorrheal conjunctivitis in adults.** *Viestnik Opht.*, 1939, v. 14, pt. 5, p. 57.

Ten brief case reports illustrate the excellent results of this form of therapy in adult blennorrhea. Very beneficial also was the injection of diphtheria antitoxin in six cases of ophthalmia neonatorum with threatened corneal complications.

Ray K. Daily.

Neuman, V. H. **The use of glass prosthesis in conjunctivoplasty after a free transplant of skin or mucous membrane.** *Viestnik Opht.*, 1938, v. 14, pt. 5, p. 45.

The author uses a glass artificial eye to hold the transplant in place. (Illustration.)

Ray K. Daily.

Nicolacopoulos, J. **Conjunctivitis in molluscum contagiosum.** *Bull. Soc. Hellenique d'Opht.*, 1939, v. 8, Jan.-March, p. 41.

Report of a case of molluscum contagiosum of the lids accompanied by follicular conjunctivitis in a young child.

George A. Filmer.

Pascheff, C. **New researches on con-**

**conjunctival plasmoma.** Klin. M. f. Augenh., 1939, v. 103, July, p. 54.

The author considers plasmoma as a local inflammatory, perhaps toxic, hyperplasia. In some cases he observed hyperleucocytosis. Plasmoma arises in the adventitia of the blood vessels, folliculoma in the endothelium. Folliculomatous hyperplasia (trachoma) develops in the adenoid stratum of the conjunctiva, plasmoma deeper in the conjunctiva, sometimes even infiltrating the orbit. C. Zimmermann.

Poleff, L. **Regarding the rickettsias of trachoma.** Arch. d'Ophth. etc., 1939, v. 3, July, p. 594.

A reply to Foley and Parrot (Amer. Jour. Ophth., 1939, v. 22, p. 1183) as to whether the so-called rickettsias of trachoma are true rickettsias.

Prado, D., and Mignone, C. **Plasmocytoma of the conjunctiva.** Arquivos Brasileiros de Oft., 1938, v. 1, Dec., pp. 99-105.

The authors' case involved both eyes, in a girl of 12 years. A photomicrograph printed in color shows typical staining of the plasmocytes. Extirpation of the masses resulted in permanent cure. (8 illustrations.)

W. H. Crisp.

Rein, W. J., and Tibbetts, O. B. **Irrigations with sulphanilamide as a treatment for gonorrheal conjunctivitis.** Amer. Jour. Ophth., 1939, v. 22, Oct., pp. 1126-1129.

Rudenko, V. F. **Cicatricial contraction of the conjunctiva in dermatitis herpetiformis Düring.** Viestnik Ophth., 1939, v. 14, pt. 5, p. 71.

This is the report of a case of shrinking of the conjunctival sac with resulting entropion which developed dur-

ing the course of dermatitis herpetiformis Düring. This form of dermatitis is therefore to be considered an etiologic factor in cicatrization of the conjunctiva, along with trachoma, burns, pemphigus, smallpox, and diphtheria.

Ray K. Daily.

Rumantzeva, A. F. **Partial and total restoration of the conjunctival sac.** Viestnik Ophth., 1939, v. 14, pt. 5, p. 38.

Of the various plastic procedures tried, the author's best results were obtained by the use of a free transplant of skin from the shoulder, large enough to line the conjunctival sac and held in place by a glass or porcelain ball. (Illustration.)

Ray K. Daily.

Starostina, O. I. **The Weil-Félix reaction in trachoma.** Viestnik Ophth., 1939, v. 14, pt. 6, p. 33.

The serum of ninety trachoma patients was tested, with negative results in all cases.

Ray K. Daily.

Trantas, N. **Notes on vernal catarrh.** Bull. Soc. Hellénique d'Ophth., 1939, v. 8, Jan.-March, p. 66.

The author discusses his study of 38 cases of vernal catarrh using the slit-lamp and Gzapski microscope. He describes in detail the pathology in the tarsal and bulbar conjunctiva, with special attention to the character and structure of meshworks of fine, white, thread-like formations.

George A. Filmer.

Trapezontzeva, E. **Rickettsias in trachoma.** Viestnik Ophth., 1939, v. 14, pt. 6, p. 29.

This, Trapezontzeva's fifth investigation on the subject, deals with the Weil-Félix reaction in trachoma. She tested the serum of 100 patients, 71 in the various stages of trachoma. The re-

action was inconstant, and she concludes that the Weil-Félix reaction has no significance in trachoma.

Ray K. Daily.

Wahlman, H. F. **Vernal conjunctivitis.** Trans. Sec. on Ophth., Amer. Med. Assoc., 1938, 89th mtg., p. 31.

The author describes several clinical forms of this disease. In his opinion tests for specific allergins and subsequent desensitization have proved of little value. He prefers solutions of acid rather than alkaline reaction. (Discussion.)

George H. Stine.

Windham, R. E. **Ocular papilloma.** Amer. Jour. Ophth., 1939, v. 22, Sept., pp. 966-971; also Trans. Amer. Acad. Ophth. and Otolaryng., 1938, 43rd mtg., p. 245.

Wood, M. A. **A study of methemoglobin-producing organisms in ocular inflammations.** Amer. Jour. Ophth., 1939, v. 22, Oct., pp. 1111-1119.

Zachert, Marian. **Antistreptin in the treatment of trachoma.** Klinika Oczna, 1939, v. 17, pt. 3, p. 428.

Antistreptin is a preparation similar to sulphanilamide. It was administered in 65 cases of severe trachoma, in addition to the usual local treatment. The author believes that its administration helps to relieve the conjunctival irritation, diminishes the granulations and secretion, and alleviates the subjective symptoms.

Ray K. Daily.

## 6

### CORNEA AND SCLERA

Adamantiadis, B. **Certain occupational keratopathies.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Jan.-March, p. 108.

In grinders and marble cutters, the cornea may be found studded with

small foreign bodies at about the level of Bowman's membrane. There is no inflammatory reaction, but the chronic trauma may give rise to an irregular astigmatism resulting in diminished visual acuity.

George A. Filmer.

Anderson, C. R., and Wilson, W. A. **Active interstitial keratitis of late prenatal syphilis; its treatment.** California and Western Med., 1939, v. 50, March, p. 196.

Thirteen acute and nine chronic cases of active interstitial keratitis were treated by means of fever therapy. The milder cases were given typhoid-paratyphoid vaccine, while the more severe ones were inoculated with malaria. Results were very encouraging, the rapid response to the use of malaria being particularly striking.

George A. Filmer.

Beam, A. D., and Lindberg, V. L. **A case of herpes zoster ophthalmicus.** Jour. Michigan State Med. Soc., 1939, v. 38, April, p. 301.

Herpes zoster is briefly described and mention made of the array of cures recommended for the disease. Walker and Walker's treatment by the use of diphtheria antitoxin (Amer. Jour. Ophth., 1939, v. 22, p. 114) is discussed at great length. The case here reported (herpetic involvement of the lids and cornea) responded favorably to two 5,000-unit intramuscular doses of diphtheria antitoxin. The authors do not draw conclusions from this single case but feel that the treatment deserves further trial.

F. M. Crage.

Cardello, Giovanni. **Herpes corneae and disciform keratitis.** Rassegna Ital. d'Ottal., 1939, v. 8, March-April, pp. 222-239.

Cardello reports eleven cases of

herpes corneae observed within one year, all within a comparatively limited area. Each patient had been affected by influenza; there were no cases of traumatic origin. Two developed a disc-like opacity, which almost entirely cleared, giving support to the belief that herpes is the cause of keratitis disciformis. Animal inoculation was positive except in cases seen late. Seventy percent of the inoculated animals developed encephalitis. The author feels that the use of neurovaccine (a filtrate of *B. pyocyaneus* and *staphylococcus aureus*) was of definite value. From three to six injections of this nonspecific serum were given and seemed to relieve the discomfort of the patient and hasten recovery.

Eugene M. Blake.

Czukrász, Ida. **Vitamin B<sub>1</sub> in the treatment of hypovitaminosis.** *Klin. M. f. Augenh.*, 1939, v. 103, Aug., p. 221.

In ten cases of hypovitaminosis with ulcers of the cornea, application of betaxin and other vitamin-B<sub>1</sub> preparations in the form of salves or injections proved very beneficial.

C. Zimmermann.

Dalsgaard-Nielsen, Esther. **On disablement and social conditions of patients with past syphilitic interstitial keratitis.** *Brit. Jour. Ophth.*, 1939, v. 23, Aug., pp. 544-556.

Material comprising 173 patients with past interstitial keratitis was examined. The author's investigations were devoted particularly to the question of whether the disease caused enough disablement to impair the practical earning power of the patient. It was noted that 79 percent of the patients themselves stated that they were perfectly capable of work, 7 percent were only partially capable, and 14

percent were probably disabled to a degree less than one third of average working capacity. The 14 percent must be considered a definite social encumbrance. The patients' statements in the main agreed with the physician's estimation of disablement. The findings of the author reveal the disabling factors to be impairment of vision, deafness, and nervous complications. Tables are offered to demonstrate these findings. The disease has not occasioned any particular reduction in social status, 38 of 51 patients holding the same social standing as their parents and 7 having advanced socially, only 6 having descended. (References.)

D. F. Harbridge.

Larsen, Victor. **Parenchymatous syphilitic keratitis and syphilitic atrophy of the optic nerve treated with sulfosin.** *Brit. Jour. Ophth.*, 1939, v. 23, Sept., pp. 585-622.

Clinically the two conditions discussed are widely different in their manifestations, but they do have one common feature: a syphilitic origin which is little influenced by ordinary antisypilitic treatment. Sulfosin, the remedy used in this investigation, is a 1-percent partly dissolved sulphur sublimate in olive oil. Seventeen cases treated with sulfosin were compared with 22 controls. The use of the drug shortened the hospital stay of the patients so treated and produced a quicker subsidence of such conditions as photophobia and lacrimation. Sulfosin did not protect against parenchymatous keratitis in the second eye but the course of the affection of the second eye was less severe than in cases not so treated. In the opinion of the author treatment with sulfosin checks, temporarily at least, atrophy of the optic nerve. Central vision, the field of vision,

and color vision may improve, improvement continuing for as long as a year after the course of treatment is terminated. Some cases are aggravated by the treatment, four such being noted.

D. F. Harbridge.

Nakhminovich, I. M. **Transplantation of peritoneum on the eyeball.** *Viestnik Ophth.*, 1939, v. 14, pt. 5, p. 32.

In the search for easily available transplant material histologically and functionally similar to conjunctiva, capable of rapidly and easily adhering to large surfaces of underlying tissue, and free of cosmetic objections, it occurred to the author to try peritoneum. He used a strip 2.5 by 1 cm. in a Denig operation for pannus. The result was excellent.

Ray K. Daily.

Pariser, Harry. **Acquired syphilitic interstitial keratitis.** *Amer. Jour. Syph. Gonorrhea, and Venereal Dis.*, 1939, v. 23, March, p. 214.

A report of two cases of interstitial keratitis occurring in patients with acquired syphilis. George F. Filmer.

Pascheff, C. **Research on true granuloma of the cornea in comparison to plasmoma, folliculoma, and fibropapilloma.** *Boll. d'Ocul.*, 1938, v. 17, Dec., pp. 978-984.

A case of true granuloma of the left cornea of a woman 54 years of age is described. The eye was red, painful, and photophobic. A white vegetation protruded from the infero-external quadrant of the corneal surface. Numerous blood vessels coming from the corresponding limbus extended superficially and deeply into the surrounding clear cornea. A histologic description is given of the neoformation. An inflammatory granuloma of the left cornea is also reported in a woman of 48 years

affected by cicatricial trachoma. The cornea was covered by a richly vascular vegetation, the eye being painful, enlarged, and hard. A histologic description is also given of this granuloma. These vegetations are prevalently vascular and contain polynuclear leucocytes, similar to the inflammatory granulations seen following wounds of the conjunctiva. They are to be differentiated from the vegetations of spring catarrh (rich in fibrous tissue and eosinophiles), from the plasmomas of the conjunctiva, and from the folliculomas seen in trachoma. (7 figures.)

M. Lombardo.

Pergola, Alfredo. **A case of traumatic herpes corneae associated with Hörner's syndrome.** *Rassegna Ital. d'Ottal.*, 1939, v. 8, March-April, pp. 197-210.

A miner aged 43 years was struck in the left eye by a chip of stone. An abrasion of the cornea resulted. After a few days of apparent improvement a typical herpetic eruption of the surrounding cornea occurred. Within a few weeks the classical symptoms of Hörner's syndrome occurred (narrowing of the palpebral fissure, enophthalmos, miosis, and localized iris atrophy). The latter condition gradually cleared and the corneal process healed with only a faint scar. The author goes fully into the differential diagnosis of corneal herpetic lesions and other changes and reviews the literature of herpes corneae. (One figure.)

Eugene M. Blake.

Rhodes, A. J. **Studies on the bacteriology of hypopyon ulcer. 3. A bacteriological investigation of 120 cases of hypopyon ulcer.** *Brit. Jour. Ophth.*, 1939, v. 23, Sept., pp. 627-630.

The results of this bacteriologic study indicate that, contrary to the findings of other workers, pneumococci

occupy a relatively unimportant place (11.6 percent). Of the cultures, 21.6 percent showed no growth, 32.4 percent diphtheroid bacilli, and 12.5 percent staphylococcus albus. Other types ranged from 0.8 percent to 3.3 percent. The investigation tends to lessen the emphasis placed on the purely infective element in hypopyon ulcer. The powers of resistance to infection of the corneal tissue are the more essential factors. (References.) D. F. Harbridge.

Roggenkämper. **Corneal ulcer and prontosil.** Klin. M. f. Augenh., 1939, v. 103, Aug., p. 221.

Within the last half year the author has systematically treated all ulcers of the cornea with prontosil. The results as to vision were surprisingly good.

C. Zimmermann.

Sandler, I. L. **Sulphanilamide treatment of syphilitic interstitial keratitis.** Arch. Derm. and Syph., 1939, v. 39, March, p. 528.

A preliminary report of a case of relapsing interstitial keratitis which responded dramatically to the administration of sulphanilamide.

George A. Filmer.

Staz, L. **An unusual condition of the posterior surface of the cornea (posterior herpes of the cornea).** Brit. Jour. Ophth., 1939, v. 23, Sept., pp. 622-626.

The condition described was observed in a young man aged 18 years, who was kept under observation for a period of practically six years. In the upper part of the corneal endothelium of the right eye there was a horizontal grayish-white band which gave the impression of being caused by ruptured vesicles. A similar condition was noted in the lower half of the left eye. Vision in each eye was 6/9, with correction

6/6. After six years observation the condition remained about the same. (Review of literature, illustrations.)

D. F. Harbridge.

Suganuma, Sadao. **Clinical and histologic findings in a case of primary posterior scleral tuberculosis.** Klin. M. f. Augenh., 1939, v. 103, Aug., p. 208.

A man of 22 years, who had a left-sided pleurisy, showed slight exophthalmos and episcleritis of the left eye, a detachment of the retina beginning near the macula, several grayish-white round foci of the choroid, and a second flat detachment of the retina in the lower periphery. Examination showed that an intrascleral tuberculoma at the posterior pole was primary in the sclera and was not a tuberculosis of the choroid with secondary involvement of the sclera.

C. Zimmermann.

Tarlovskaja, S. I. **Lysozyme in the therapy of corneal diseases.** Viestnik Ophth., 1939, v. 14, pt. 5, p. 20.

Of 53 cases of ulcus serpens and infected corneal wounds following burns and traumatism treated with lysozyme, there was a favorable effect in 81.1 percent, a doubtful effect in 13.2 percent, and a negative effect in 5.7 percent. The author urges the inclusion of lysozyme among the therapeutic agents used in keratitis. Its bactericidal potency is higher than that of any other antiseptic, it acts as an analgesic, stimulates epithelization and regeneration, and is harmless. The effect usually manifests itself in five or six days, but sometimes not until the tenth or eleventh day.

Ray K. Daily.

Tichova, V. A. **Local vitamin therapy in ocular diseases.** Viestnik Ophth., 1939, v. 14, pt. 5, p. 16.

In the author's experience instillation

of cod-liver oil with vitamin D produced favorable results in hitherto resistant cases of various types of keratitis, the favorable effect being manifested by the shortened duration of the disease and by the end result. The oil acts as an analgesic, diminishes blepharospasm, and hastens epithelization. Miotics augment the effect of the cod-liver oil.

Ray K. Daily.

Tjanidea, T., and Manoussis, S. **Corneal transplantation after the method of Filatov-Nižetić.** Bull. Soc. Hellénique d'Ophth., 1939, v. 8, Jan.-March, p. 115.

The authors present a case and describe their operative procedure. They use and recommend the bistoury and trephine of Nižetić.

George A. Filmer.

Windham, R. E. **Ocular papilloma.** Amer. Jour. Ophth., 1939, v. 22, Sept., pp. 966-971; also Trans. Amer. Acad. Ophth. and Otolaryng., 1938, 43rd mtg., p. 245.

## 7

### UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Chavira, R. A. **Sympathetic ophthalmia.** Anales Soc. Mexicana de Oft. y Oto-Rino-Laring., 1938, v. 13, July-Dec., pp. 33-39.

Relates three cases following accidental injury and one following cataract operation.

Drake, M. E., Renshaw, R. J. F., Modern, F. S., and Thienes, C. H. **The smooth muscle actions of epinephrine substitutes. 7. Responses of denervated smooth muscles of iris and intestine to epinephrine, ephedrine, amphetamine (benzedrine), and cocaine.** Jour. Pharm. and Exper. Therapeutics, 1939, v. 66, July, p. 251.

The iris of cats and rabbits was denervated by excision of the superior cervical ganglion. Mydriasis in the normal eye was caused by instillation of epinephrine, ephedrine, amphetamine, or cocaine, but was prevented by denervation. No final conclusions were drawn concerning the site and manner of peripheral action of these drugs. The evidence is definitely against sympathicotrophic effects, but gives little support to a musculotropic action.

T. E. Sanders.

Filatov, V. P. **Treatment and prophylaxis of myopic chorioretinitis.** Vestnik Ophth., 1939, v. 14, pt. 6, p. 18.

The effectiveness of osmotherapy in the form of intravenous injections of 10-percent saline solution, of transplantation of preserved skin on the temples, and of intramuscular cod-liver-oil injections is demonstrated in brief clinical case reports.

Ray K. Daily.

Koch, C., Schreiber, B., and Schreiber, G. **Metaplastic osteoplasia in transplantation of the urethra into the anterior chamber of the guinea-pig eye.** Ophthalmologica, 1939, v. 97, July, p. 284.

Urethral segments of embryo and adult guinea pigs were transplanted into the anterior chamber of the eye of the guinea pig. Eight transplants were done and examined histologically. In all of them, bone formation was induced in contiguous new-formed connective tissue. Osteoplasia was noted as early as the eighteenth day. The great, if not specific, ability of the urethra to induce bone formation is pointed out.

F. Herbert Haessler.

Rosner, L., and Bellows, J. **The passage of sorbitol from the blood into the aqueous and cerebrospinal fluid.** Amer.

Jour. Physiology, 1939, v. 125, April 1, p. 652.

Sorbitol injected intravenously produces a fall in intraocular pressure as a consequence of its osmotic properties. Glucose also produces this effect, but, because it later diffuses readily from the blood into the aqueous, the intraocular pressure rises again. Sorbitol, however, was found to pass from the blood into the aqueous in relatively small amounts. (Tables.)

George A. Filmer.

Samuels, B. **Ossification of the choroid.** Trans. Amer. Acad. Ophth. and Otolaryng., 1938, 43rd mtg., p. 193.

The author has made an exhaustive study of 81 ossified globes enucleated mostly because of atrophy, phthisis, or secondary glaucoma. He concludes among other things that traction is the important stimulus for formation of bone, that danger of sympathetic ophthalmia from globes ossified after perforation is practically nonexistent, and that development of sarcoma is also unlikely. (38 illustrations, bibliography, discussion.)

George H. Stine.

Shevelev, M. M. **Activation of the sympathizing eye after cataract extraction on the other eye.** Viestnik Opht., 1939, v. 14, pt. 6, p. 71.

A report of two cases. Each of the patients had had an old injury in one eye with cataract in the other and had had the cataract extracted. The operated eyes developed sympathetic ophthalmia. In one case the eye recovered following enucleation of the injured eye. In the other case, delayed because of the patient's objection, the enucleation was done too late to save the operated eye. These occurrences point to the advisability of enucleating a blind

eye previous to surgical operation on the fellow eye. Ray K. Daily.

Volokitenko, A. E. **Osmotherapy in myopic chorioretinitis.** Viestnik Opht., 1939, v. 14, pt. 6, p. 22.

An analysis of the results in 24 cases treated with intravenous injections of 10-percent sodium chloride. The report shows improvement in visual acuity in 84.5 percent of the cases. The visual field expanded 20 to 30 percent in five cases, 8 to 19 percent in eleven cases, and in five cases remained unchanged. Absolute scotomata, present in 11 cases, disappeared in two cases, diminished in size in two cases, and remained unchanged in seven. The author urges the use of osmotherapy as a harmless and effective therapeutic procedure.

Ray K. Daily.

Zenkina, L. V. **Pigment-epithelium changes in the anterior chamber.** Viestnik Opht., 1939, v. 14, pt. 5, p. 69.

Pigment vesicles developed on the lens capsule in the course of severe traumatic iridocyclitis. They were demonstrable only with high biomicroscopic magnification. The author believes them to have been groups of cells of the posterior layer of the pigment epithelium of the iris, which had become vesicular as a result of hydropic changes. (Illustrations.)

Ray K. Daily.

## 8

### GLAUCOMA AND OCULAR TENSION

Casini, Francesco. **Considerations and researches in a case of chronic simple glaucoma with delayed hypertension.** Arch. di Ottal., 1939, v. 46, Jan.-Feb., pp. 40-70.

The patient, a woman of 66 years, complained of failing vision and violent

pains over the eyes, sometimes accompanied by vomiting. The visual fields showed marked contraction, there was moderate excavation of the discs, the right pupil was moderately and the left decidedly dilated, and the anterior chambers were shallow. The left iris had areas of atrophy and the left vitreous was cloudy. The tension of the right eye was 18 mm., that of the left eye 15 mm. (Schiötz). Intradermal injections of caffeine and of histamine produced strong positive reactions, the tension of the right eye rising to 44 mm. and that of the left eye to 65 mm. under histamine. After each such experiment the tension was easily brought back to normal with eserine. The author reviews the literature relating to chronic simple glaucoma with delayed hypertension and to glaucoma without hypertension. W. H. Crisp.

Gandolfi, C. **Behavior of the retinal vessels under glaucomatous pressure.** *Ann. di Ottal.*, 1939, v. 67, June, p. 433.

The author studied a group of glaucomatous eyes taking both the general blood pressure and that of the retinal arteries, employing the method of Bailiart. He concluded that a higher blood pressure helps to maintain the capillary flow necessary for the nutrition of the neuroretinal elements, and is in agreement with the observation of Lauber that when the blood pressure is low the prognosis is not so favorable as when it is high. (Bibliography.)

Park Lewis.

Hamburger, Carl. **On the treatment with "glauconan" of cases of glaucoma operated upon without success, and of complicated cataracts.** *Brit. Jour. Ophth.*, 1939, v. 23, Aug., pp. 557-567.

A discussion of how glaucoma is to be treated when surgical intervention has failed or, at best, resulted in only

temporary success. It is the author's opinion that a second operation should not be attempted until the use of glaucosan drops has been given a trial. Two cases are presented to demonstrate the advantages of this treatment, and a detailed explanation of the steps in glaucosan massage is given. A further presentation of cases demonstrates the use of glaucosan drops in complicated cataracts. (Tables.) D. F. Harbridge.

Odintzov, V. P. **Conservative and surgical treatment of glaucoma.** *Viestnik Opht.*, 1939, v. 14, pt. 6, p. 3.

A review of the literature, an emphasis on the fact that glaucoma is a general and not a local disease, and a plea for individualization in treatment. The surgical procedures used by the author are Elliot trepanation and cyclodialysis. Ray K. Daily.

Reese, A. B. **The value of early operation in chronic primary glaucoma.** *Jour. Amer. Med. Assoc.*, 1939, v. 113, Sept. 23, p. 1204.

From a study of 105 selected cases of chronic primary glaucoma in both early and advanced stages, the author concludes that the disease is quite tractable if operation, when indicated, is done in the early stages. For best results the operation should be done before there is enlargement of the blind spot and constriction of the field, and certainly before there is any cupping of the disc. (Discussion.)

George H. Stine.

Rosner, L., and Bellows, J. **The passage of sorbitol from the blood into the aqueous and cerebrospinal fluid.** *Amer. Jour. Physiology*, 1939, v. 125, April 1, p. 652. (See Section 7, Uveal tract, sympathetic disease, and aqueous humor.)

## NEWS ITEMS

Edited by DR. H. ROMMEL HILDRETH

640 S. Kingshighway, Saint Louis

News items should read the Editor by the twelfth of the month

### DEATHS

Dr. Frederick Stauffer, Monterey, California, died July 20, 1939, aged 72 years.

Dr. James Homer Buckley, Fort Smith, Arkansas, died July 31, 1939, aged 64 years.

### MISCELLANEOUS

The American Board of Ophthalmology announces a written examination, March 2, 1940, in various cities throughout the country. This will be the only written examination in 1940. All applications for this examination must be received before January 1, 1940. All applicants must pass satisfactory written examination before being admitted to oral examination. Oral examination: New York City, June 8th and 10th. Fall examination to be announced later. Case reports: Candidates planning to take June examination must file case reports before March 1st. For application blanks write *at once* to Dr. John Green, 6830 Waterman Avenue, Saint Louis, Missouri.

George Brewster and Jennie Mathews Honorary. An honorarium of \$1,000 to promote research work in ophthalmology is offered through the International Association for the Prevention of Blindness, the jury to consist of the Executive Committee together with the president and the officers of the Association.

The award will be made in connection with the XVIth Concilium Ophthalmologicum. Papers may be presented by any responsible research worker. The subject is to be "Simple non-inflammatory glaucoma" and may include anything definitely relative to the question. The matter must be new and of such value, in the judgment of the jury, as to merit this recognition. Papers may be written in English, French, German, or Italian; in order to facilitate the task of the jury, papers written in the last two languages should be accompanied by a translation in English or French. They should be in the hands of the secretary of the International Association for the Prevention of Blindness, 66 Boulevard Saint-Michel, Paris, through whom they will reach the members of the judicial committee, not later than six months before the date of the Congress. The decision of the jury will be final.

### SOCIETIES

The twenty-fourth annual meeting of the International Medical Assembly, Inter-State Postgraduate Medical Association of North America, was held October 30 to November 3, 1939, in Chicago. Dr. Albert D. Ruedemann, Cleveland

Clinic, gave the Joseph Schneider Foundation presentation. His subject was "exophthalmos."

The North of England Ophthalmological Society held a slitlamp course, open to all ophthalmic surgeons, at Sheffield on September 25-29, 1939. Mr. Harrison Butler and Mr. Basil Graves were the lecturers.

The International Council of Ophthalmology met in London on April 19, 1939. Themes discussed were: 1. Plastic operations on the eyeball, 2. The pathology of retinal detachment, including the biology and pathology of the vitreous body.

The National Society for the Prevention of Blindness held its annual meeting in New York on October 26 to 28, 1939. The program included: Nursing as it relates to sight conservation; Sight conservation in industry; The doctor in conserving the sight in the pre-school child; Social work in preventing blindness; Sight-saving classes. A subscription dinner was held on two evenings of the meeting.

The following officers have been elected for the New York Society for Clinical Ophthalmology for the coming year: president, Dr. Arthur M. Yudkin; vice-president, Dr. Morris Davidson; recording secretary, Dr. Sidney Fox; corresponding secretary, Dr. Benjamin Esterman, 515 Park Avenue, New York; treasurer, Dr. Adolph Posner. Meetings are on the first Monday evening of each month, October through May.

The following program for the November 6th meeting of the Washington, D.C., Ophthalmological Society was given: Malignant melanoma, by Colonel G. R. Callender; Field changes following satisfactory filtration operation for glaucoma, by Dr. John W. Burke. Case presentations by Drs. E. Leonard Goodman, Joseph Dessoff, and Robert F. Costello.

### PERSONALS

The Journal wishes to correct a personal news item in the October issue, in which it was stated that Dr. Karl Ascher, now associated with the Department of Ophthalmology of the University of Cincinnati, was the successor of Dr. Elschnig as head of the Department of Ophthalmology of the German University of Prague. Dr. Ascher was not Dr. Elschnig's successor but was professor extraordinarius, a position corresponding to that of associate professor in our country.

AMERICAN JOURNAL OF OPHTHALMOLOGY  
**PRESCRIPTION OPTICIANS**

**BOSTON, MASS.**

Bartlett &amp; Son Company

346 Boylston Street

Specialists in the making of Eyeglasses  
and Spectacles from Oculists' prescriptions.**BOSTON, MASS.**

Pinkham &amp; Smith Company

292 Boylston Street

15 Bromfield Street

Established 1896

Member Guild of Prescription  
Opticians of America

144 Joralemon St.

23 Bond St.

**BUFFALO, N.Y.**

Buffalo Optical Company

559 Main Street

Peter Meyer, Oscar Cleal, Herbert Derrick  
—Established 43 Years—Member Guild of Prescription Opticians of  
America**CHICAGO, ILL.****Almer Coe & Company***Optical, Photographic & Meteorological Instruments*

PRESCRIPTION OPTICIANS

Established 1886

Ophthalmic Instruments—Microscopes

Fine Spectacles to Prescription

Member-Guild of Prescription Opticians

**DENVER, COLO.**

Paul Weiss, 1620 Araphoe Street

Prescription Optician

Established in 1894

Optical Specialties made to order.

**EAST ORANGE, N.J.**

H. C. Deuchler

Guildcraft Optician

541 Main Street

Eye Physicians prescriptions exclusively

Member Guild of Prescription Opticians  
of America**PORTLAND, ORE.**

Hal H. Moor, 315 Mayer Bldg.

Dispensing Optician

Oculists' prescriptions exclusively

**PASADENA, CALIF.**

Arthur Heimann

Guild Optician

36 N. Madison Ave.

**NEWARK, N.J.**

J. C. Reiss, Optician

Dispensing Exclusively

10 HILL STREET

Oldest Optical House in New Jersey

Established 1892

Member Guild of Prescription Opticians of  
America**NEW YORK CITY**

INCORPORATED

Optician Established 1875

520 Fifth Ave., New York

255 Livingston St., Brooklyn

Member Guild of Prescription Opticians of  
America**PHILADELPHIA, PA.**

Prescription Opticians—since 1890

**SAN FRANCISCO, CALIF.**

PRESCRIPTION OPTICIANS

234 STOCKTON ST., AT UNION SQUARE

**ST. LOUIS, MO.**

Erker Bros. Optical Co.

610 Olive Street

518 N. Grand Boulevard

Established 1879

Member Guild of Prescription Opticians of  
America



# 'T WAS THE DAY AFTER CHRISTMAS



'Twas the day after Christmas, and up at the Pole  
St. Nick had returned from his gift giving role.  
With spirits so merry and heart that was light  
He thought of the presents he'd spread through the night.



"These doctors are clever," he chuckled with pride  
As he counted the offices he'd been inside.  
Why, during the wee hours he'd had to troop  
To many a suite with a lens set or loupe.



At professional offices he'd left behind  
Refractors, projectors, and things of that kind  
As gifts the refractionists knew they would need  
In helping their practices thrive and succeed.



"The man who invests in his practice is wise,"  
He said with a gleam in his knowing old eyes,  
"I've been around and I surely can tell  
That he's twice as wise who buys B & L."

**RIGGS OPTICAL COMPANY**

*Distributors of Bausch & Lomb Products*



## IMPOSSIBILITY of IMPORTING ARTIFICIAL EYES has not affected MAGER & GOUGELMAN SERVICE

For those Eye Physicians located in other cities in which adequate stocks of artificial eyes are not available, we have developed a method whereby patients who cannot visit one of our offices are no longer denied the advantage of good matching. Thru the use of our color and size chart (sent gratis to eye-physicians) and the mailing of selections on memorandum, eye physicians are enabled to fit their patients anywhere with a minimum of delay and expense. Charge is made only for the eye retained, all others being returnable at no cost. Over 125,000 eyes, no two alike, from which to make the perfect selection.

For over eighty-eight years this house has specialized in the making and fitting of artificial eyes. Constant research and contact with the world's leading eye physicians has developed many improvements from the earlier efforts until today Mager & Gougelman are acknowledged the leading artisans in this country.

## MAGER & GOUGELMAN, Inc.

### WESTERN DIVISION

CHICAGO  
30 N. Michigan Ave.

DETROIT  
805 Empire Bldg.

MILWAUKEE  
630 Empire Bldg.

KANSAS CITY  
1300 Rialto Bldg.

CLEVELAND  
913 Schofield Bldg.

PITTSBURGH  
801 May Bldg.

ST. LOUIS  
801 Metropolitan Bldg.

MINNEAPOLIS  
325 Medical Arts Bldg.

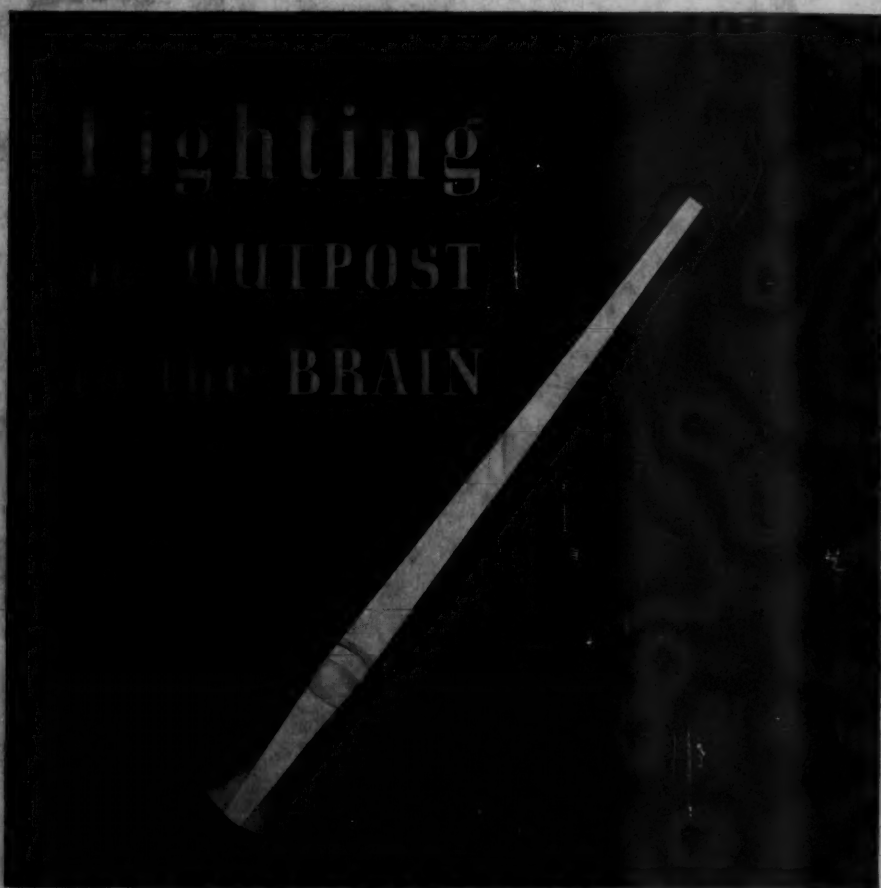
### EASTERN DIVISION

NEW YORK  
510 Madison Ave.

PHILADELPHIA  
1930 Chestnut St.

BOSTON  
230 Boylston St.

WASHINGTON, D.C.  
311 Albee Bldg.



AO May  
Ophthal-  
moscope.

It's a tiny thing, this bright ray of light from an AO Ophthalmoscope, but it shines as a guiding beacon to the brain—the optic disk—and that telltale chart of neurological and pathological disease—the fundus oculi. American Optical Company is proud of the men of science who developed an Ophthalmoscope second to none, and who continue to work ceaselessly in the advancement of instruments so vital to ophthalmology.

## AMERICAN OPTICAL COMPANY

*World's Oldest and Largest Makers of Ophthalmic Products*

Factories at Southbridge, Mass.—Branches in 255 Principal Cities in the United States and Canada.

